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CATERPILLARS,

BUTTERFLIES, AND MOTHS.

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DEPARTMENT
OF
ENTOMOLOGY

SWALLOW-TAIL.

PEACOCK. { CATERPILLAR. CHRYSALIS.

THE "OBSERVING EYE" SERIES.

BRITISH MUSEUM (NAT. HIST.)
DEPARTMENT OF ENTOMOLOGY

CATERPILLARS, BUTTERFLIES, & MOTHS:

AN ACCOUNT OF THEIR HABITS, MANNERS, AND TRANSFORMATIONS.

BY

MARY AND ELIZABETH KIRBY,

Authors of "Plants of the Land and Water," &c.

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WITH

ILLUSTRATIONS BY EMILY BOLINGBROKE.

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PREFACE.

To put into the hands of young persons the scientific works from which the following information has been gleaned, and to expect them to understand them, would be very much like giving a labouring man the Greek Testament, and expecting him to read it. The difficulties in the way of arriving at the meaning of obscure sentences, the having to pick the thread of facts from a tangled skein, and to write them into a clear and connected narrative, those only can know who have made the attempt. Whether the attempt in the present case is satisfactory, remains with the public to decide.

Norwich, May, 1860.

CONTENTS.

CHAPTER THE FIRST.

PAGE

Eggs from which Caterpillars are to come .. 9

CHAPTER THE SECOND.

The Caterpillar 19

CHAPTER THE THIRD.

Solitary Nests 40

CHAPTER THE FOURTH.

Social Nests 50

CHAPTER THE FIFTH.

The Mischief Caterpillars can do 58

CHAPTER THE SIXTH.

Enemies of the Caterpillar 69

CHAPTER THE SEVENTH.

The Chrysalis 80

CHAPTER THE EIGHTH.

Cocoons, but not of Silk 90

CHAPTER THE NINTH.

PAGE
Cocoons of pure Silk 101

CHAPTER THE TENTH.

The Escape of the Moth 112

CHAPTER THE ELEVENTH.

The Transformation 121

CHAPTER THE TWELFTH.

The Butterfly 128

CHAPTER THE THIRTEENTH.

The Moth 143

CATERPILLARS.

CHAPTER THE FIRST.

EGGS FROM WHICH CATERPILLARS ARE TO COME.

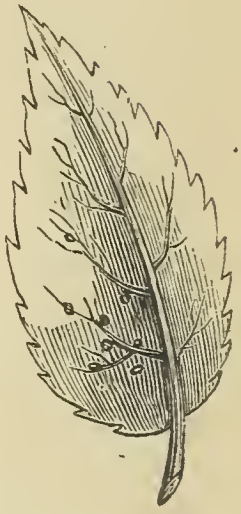
THERE is an old riddle, or nursery rhyme, that you may perhaps remember to have guessed, and the answer was, an egg:

"In marble walls as white as milk,
Lined with a skin as soft as silk,
Within a fountain crystal clear,
A golden apple doth appear.
No doors there are to this stronghold,
Yet thieves break in and steal the gold."

This is a description of a bird's egg; but a moth or a butterfly's egg, from which a caterpillar is to come, is a very different thing.

It is, to begin with, no larger than a pin's point, and when a number of these eggs are on a leaf, the leaf looks as if it were sprinkled with minute dots. But the dots are very firmly fixed,

thanks to the mother moth or butterfly who laid them there; for Nature has given her a gum, that she uses to stick them to the leaf. The gum makes a coating, like varnish, and is useful in two ways; it keeps them fast upon the leaf, and it screens them from cold wet weather.



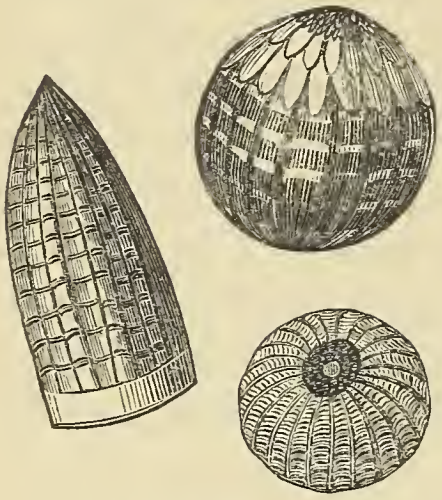
Now the shell of these little eggs is not brittle, like a bird's egg. It is, in fact, no shell, but a transparent skin; and has no lime in it, for lime, as I dare say you know, gives to the hen's egg its whiteness and brittleness. Then, the eggs of birds are pretty much the same in shape; but the little eggs I am talking about, are all manner of shapes. Sometimes they are round, sometimes like a cone, or else like a flask, or long and narrow, like a carraway seed. There is no end to their varieties.

And just the same may be said of their colors. Those laid on the nettle are green, exactly like the plant; those on the grey bark of the willow are purple, and those on the cracks and crevices of the elm are of a light pink. On the poplar they are of a shining brown, and on the cabbage leaf you would find them yellow. The color of

the egg is often caused by the yolk shining through; for if you remember, I told you the shell, or skin, was transparent. But sometimes it will have opaque dots on it, which give the egg a speckled look. Or else all the shell will be opaque, except two or three rings or bands round it; and the yolk shining through these rings, makes it look as if it were striped with different colors. Some eggs will even change from one color to another. In one case they are first yellow, then green, then rose color, and last of all, black.

You would be surprised to see how beautiful some of these eggs are! Though so tiny, they are often figured all over, in a pattern, as if they had been carved; a thing quite unknown in a bird's egg. Others are ribbed from the top to the bottom; and when the caterpillar is ready to come out, the ribs open, and give it a free passage. And others have a little lid at the top, that the caterpillar has only to push open with its head. The egg of one moth is covered with a net-work of six-sided meshes; and the egg of another is equally curious, for it has a number of little tiles at the top, lying one over the other, like a roof. We cannot tell why these minute atoms should be finished with such care and beauty. We can only admire them as the work of an Almighty

hand; and feel sure, that if the microscope were to bring before us still more minute forms of creation, we should find them, also, moulded with the same delicacy and skill.



Eggs magnified.

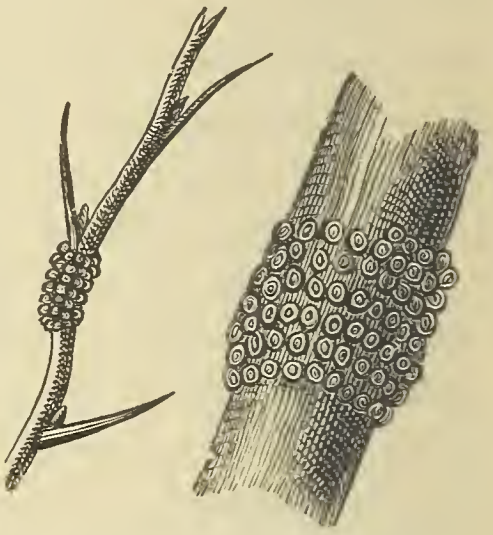
There is one more distinction between the egg of a butterfly, and that of a bird. In the bird's egg, the white and the yolk are separated, and each is enclosed in a thin membrane, like a bag. But there is no such division in the butterfly's egg, and the contents are all mixed up together. If you looked at one of them through a microscope, you would see a number of tiny grains, or globules, floating about in a liquid. This liquid is like the white in a bird's egg, since it serves as nourishment for the caterpillar while in its shell; and the grains or globules answer to the yolk, and will become, in process of time, the caterpillar itself.

Long before the little caterpillars are hatched, the mother will be dead. She seems to know this, and chooses a suitable place for her eggs, and

where her young ones may have an abundance of food. She herself only sips the nectar of flowers, and you might think she would collect a store of the same delicious food for her offspring. But instinct teaches her better. It is not a butterfly, but a caterpillar for which she has to care; and she knows that it will want green leaves to eat, as soon as it comes out of its shell. So she lays her eggs on exactly the right plant, the one that the caterpillar will like to feed upon the best. The small tortoise-shell butterfly always chooses the nettle; and another of the same family prefers the hop. Some, however, are not quite so particular, and will lay their eggs on every tree and plant, from the sweet-briar to the oak.

But the forethought of the mother does not end here. If the eggs are to be hatched that summer, she merely gums them to the leaf, as they will need no defence from cold or stormy weather. But this would never do, if they are to lie, as many eggs do, until the spring; for then the leaf would wither, and be blown away by the winds of autumn. In this case, she does not fasten them to the leaf at all, but to the trunk, or to the branch; and covers them with a shell, thick enough to resist the weather, and packs them as close as possible, filling up the gaps with a hard strong gum.

If you take the trouble to look about in the hedges, in the winter time, you may see, here and there, a twig with a tiny circle round it, like a bracelet; and if you break the twig, you can slip the bracelet off. It is made of the eggs of a brown-coloured moth, called the lackey moth,* so named because the caterpillar is striped like a man in livery, and it is well worth stopping a few minutes to examine. The eggs are wider at the top than at the bottom, and fit into each other very much like the arch-stones of a bridge. The cement that binds them together, is so hard and firm, that it is no easy matter to break it; and as it cannot be dissolved in water, or any other liquid, no amount of rain will do the eggs any harm.



Bracelet of eggs. Natural size and magnified.

But some moths go further even than this, and provide an outer covering of warm material for their eggs.

* Clisiocampa neustria.

A moth, called the gypsey moth,* has the hinder part of her body covered with down. She does not want the down to keep her warm, since she only lives a week or fortnight in the hottest days of August. She strips it off to make a covering for her eggs, and I will tell you how she does it. She carries a pair of tweezers at her tail, that are quite as useful to her as a pair of hands; for she can turn them about, and stretch them to whatever length she requires.

When she is going to lay her eggs, she places herself on the trunk of an oak or an elm, and pulls off a little piece of down from her body, and makes a bed of it, for her first egg. Then she lays another egg, and another, placing them one on the top of the other, in the form of a cone. The eggs stick together, as well as to the tree, because of the gummy substance that covers them, and that also helps to pull the down from the body of the moth. When she has finished, she plucks off more down, and roofs over the little cone of eggs with the greatest care, making the hairs point all one way, like the tiles of a house.

Sometimes the moth is two days in completing her cone; and even when she takes a little rest, she does not quit the spot or change her position. She uses up every atom of down from her body;

* Hypogymna dispar.

though this does not matter, as she has nothing now to do but to die. The eggs lie unhatched through the remaining heat of summer, and the cold and snow of winter. But when the spring comes, and the tree puts forth its leaves, the little caterpillars will make their appearance, and begin to feed upon the young and tender foliage.

The gypsey moth is very rarely found in England; but there is a pretty moth, that you may often see, sticking to the bark of trees, and that has a tuft of golden hairs at her tail. She is called the gold-tail moth;* and uses her tuft for the same purpose as the gypsey moth does the down.

The instinct of this little creature to provide for her young, seems to work quite a change in her habits. By nature she is slow and sluggish, and does not like the trouble of moving; but she is quick and active enough while she is using her tweezers. It is wonderful to see with what dexterity she pinches off a bunch of hair, places an egg upon it, and covers it over with another bunch; taking care, like the gypsey moth, to smooth the hairs all one way.

One funny-looking moth, called the vapourer moth,† has hardly any wings at all. As she

* Porthesia chrysorhœa. † Orgyia antiqua.

cannot fly, she makes use of the materials within her reach, and what do you think she does? Close by her, lies the cocoon or case, that she has just crept out of. Nothing can be more luxurious than this silken couch, and so the moth seems to think. She fixes her eggs to the outside of the cocoon; and as the cocoon itself is always suspended in some sheltered place, beneath the arm of a tree, or behind a wall or gate, the eggs are kept very warm, and hatched all the sooner.

Vapourer Moth.

But the mother moth or butterfly seems also to know what the habits of the caterpillar will be. Some caterpillars choose to live each one by itself, and then it is said to be of the solitary species. Others will feed together, and form colonies, having but one nest in common, and then they are of "the social kind."

This is always provided for by the mother. If her eggs are of the solitary species, she will often lay but one on a leaf, and allow plenty of space for the little hermit to indulge its unsociable disposition. But should they be of the social kind, she lays them in a group, or packs them into a solid cone, as we have seen the gypsey moth do.

To provide for her offspring, is indeed all that the moth or butterfly has to do, in the space of her short life; and when she has finished her task, she dies. We shall next see what sort of creatures the little caterpillars will be, and what lives they are intended to lead.

CHAPTER THE SECOND.

THE CATERPILLAR.

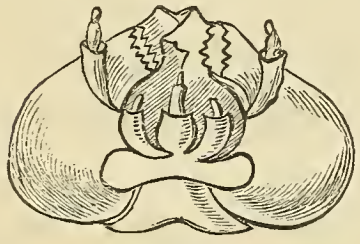
The caterpillar comes into the world with an excellent appetite, and the first thing it does is to begin to eat. It is very small, as you may suppose from the tiny shell that contained it; but its stomach fills nearly the whole of its body, and it will feed ten or twelve hours a day. It grows even while you are looking at it, and in a very little time you would hardly know it to be the same.

As its mouth is just now the most important part of its body, we will describe that first. It has two very strong jaws, hard and horny; and capable of devouring any amount of food. They do not move up and down, as yours do, but from side to side; and the teeth are not fixed in sockets, but are merely pieces of the jaw itself, that stand up like teeth.

The caterpillar has a second pair of jaws, that are placed below the others, on each side of its under lip. They are soft and fleshy; and are used to hold the food, while the other jaws eat it.

You may see from this, how well the caterpillar is provided with the means of carrying on its sole occupation, that of eating. And a very important occupation it is; for the caterpillar has to lay up a store of nourishment, sufficient to last its whole life through. It cannot eat when it is a chrysalis; and when it becomes a butterfly, its stomach shrinks to a thread. Then the greedy worm, whose appetite could never be appeased, comes forth a winged creature, adorned with the gayest colors; and fluttering from flower to flower, scarcely sips the honey and nectar as it passes. No one could guess that the two, so different in their habits and appearance, were yet so nearly related to each other, as to be one and the same.

On each side of the caterpillar's under lip is a minute feeler, and between these is the spinnaret, one of the most important organs it has. Through this it draws out the silken thread, that serves it for so many purposes. The fine yellow gum, of which the thread is made, is stored up in two long slender vessels, that run down each side of the body, and meet at the spinnaret, where there is an opening to let it pass. As soon as



Spinnaret magnified.

the gum is exposed to the air, it is no longer gum, but silk; and the caterpillar can spin it fine or coarse, flat or round, just as it likes, by contracting or dilating the spinnaret, so as to make the opening larger or smaller.

You shall hear more of the spinnaret by and bye, and also of the various uses the caterpillar makes of its thread. It is a wise and beautiful provision of Nature, to afford a creature so helpless, the means of constructing its dwelling, and sheltering itself, in some degree, from its enemies. And man has likewise found a treasure in the spinnaret, and by his ingenuity, has turned it to account from the earliest ages of the world.

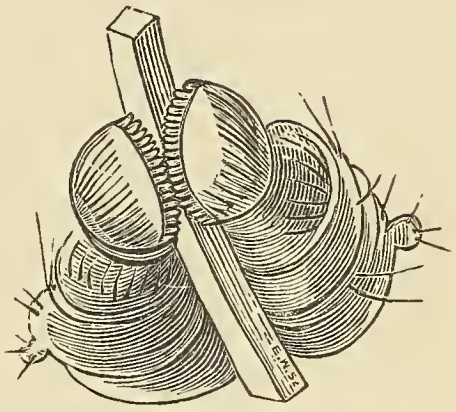
But to go on with the description of the caterpillar. The head is divided into two lobes, very rarely into three, as in the case of some species found in Brazil. The lobes sometimes end in two horns, which can be drawn in and out, like the horns of a snail; and they often give out a disagreeable odour, that is useful in driving away other insects, enemies to the caterpillar. On each side of the head are six eyes, though they are so small you can hardly see them without a microscope; and some caterpillars, when they have changed their skins a few times, strange to say, lose all appearance of eyes.

They can, however, hear, and that very quickly. A French naturalist made a number of experiments to ascertain the fact. He found that he could startle caterpillars by the sound of his voice; but not satisfied with this, he tried the effect of ringing a bell near to some that were moving quickly about. They instantly stopped, lifted up their heads and twisted them round, as if to ask what was the matter, or as if they were made uncomfortable by the sound.

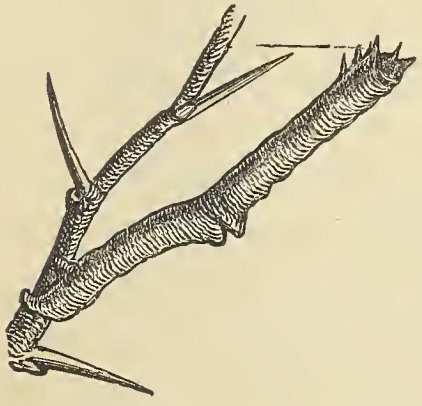
The caterpillar has two kinds of legs as well as of jaws, and its hinder legs are, in their way, great curiosities. Their principal use is to support the body by holding it firm to the branch or twig where the caterpillar is feeding; and they are as well adapted for this purpose, as the jaws are for satisfying its appetite. They are soft and fleshy, and can be drawn in or out, so as to be made longer or shorter at pleasure.

At the end of the leg is a foot, exactly fitted for the purpose of clasping the twig. The sole of the foot expands into a broad plate, that is furnished all round the edge with a row of hooks, one long and the next short, as you will see by looking at the picture. When the caterpillar stretches out its foot, these hooks lay hold of every little roughness or inequality, and enable it to cling to, what appears to us, a smooth surface. And

when it wants to suspend itself with its head downwards, as many caterpillars do, for they seem to like this strange uncomfortable attitude it has nothing to do but to clasp the branch with its hinder legs, and let itself swing. Then its strong muscles, about which you will hear directly, come into play. No one of us could remain in this position longer than a few seconds, but the caterpillar will hang for a whole day with its head downwards, and be none the worse. It will also clasp its hinder feet to the branch, and stretch itself straight out in an upright position, without any other support. Then it looks like a bit of dry stick, all the more, because of the little knobs on its body, that resemble the notches of the twig. A gardener once thought one of these caterpillars really was a dead twig, and was going to break it off;

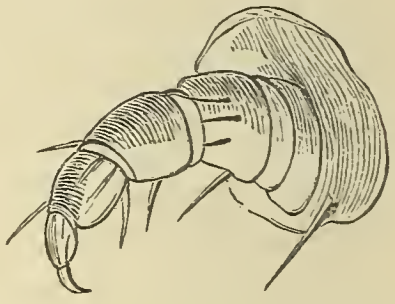


Hinder legs magnified, clasping a twig.



but when it moved in his fingers, he dropped it in a fright, and felt for a moment as if the twig were alive.

The hinder legs, although they are so useful to the caterpillar, would be of no use at all to the butterfly, who will not want to cling to branches, or to eat leaves; so they disappear altogether, when the caterpillar changes into a chrysalis. For this reason they are called *false legs.*



Fore-leg magnified.

The caterpillar uses its fore-legs to walk with; they are always six in number; and hard and horny, and end not in a foot, but a claw. It will never lose these, as it does the others, for they become the legs of the butterfly, and are called *true legs.*

In the caterpillars of moths, the hinder legs are often without the fleshy plate I have been been describing. Indeed, in some cases they will have no hinder legs at all, or only a single pair, leaving the middle of the body without; and this makes a great difference in their manner of walking. Those with legs to every ring, keep flat to the ground, and walk very fast, moving

their rings one after the other as if a wave were flowing through their bodies. But the caterpillar with no legs in the middle of its body, lays hold of the branch with its fore-legs, and draws its tail close up to them, bending its body into a loop or arch. It is called a looper, because it gets over the ground by making a succession of these said loops.

A Looper.

There is a very extraordinary caterpillar, found in India, and America, that has no legs of any kind. It hardly looks like a caterpillar, though by and bye it will change into a chrysalis, and become a moth.* Where the legs should be, are a number of fleshy protuberances, that enable it to shuffle along; and underneath its body is a

* Limacodes, from *limax*, a snail.

soft membrane, covered with a slimy substance, that still further helps it to slide or crawl like a snail, for it can hardly be called walking.

Caterpillar of Limacodes cippus.

There is another foreign caterpillar* that does anything but crawl. It has legs, and makes good use of them, for it darts along so swiftly that it

* Bombyx leporine.

is named after the hare, because of its great speed. And a third is really wonderful for the quickness of its movements. If you touch it, it darts backwards and forwards with such rapidity, that it actually seems to fly.

But there are caterpillars in our own country, that do not fly from branch to branch, but jump, which is almost as extraordinary. One of these jumping caterpillars,* when it wants to descend from one branch to another, crawls to the edge of the leaf and peeps over. Then it goes a little back, and bending its body like a cat, leaps through the air. No matter what the distance, it always alights upon its feet.

But I must next explain to you how the caterpillar breathes. It does not draw in the air through its mouth as you do; but down each side of its body are little holes, called spiracles, and it breathes through them, as through so many mouths. The holes are very much exposed; but to protect them from dust, and everything else that might choke them, they are fringed round with minute hairs, that interlace each other, and allow nothing but the air to enter. Two tubes, that answer the purpose of wind-pipes, lie on each side within the body, and the spiracles run into them. A great many smaller tubes

* Noctua auadra.

branch off from these larger ones, and carry a supply of air through the whole body.

A fluid, something like the blood of animals, is stored up in a vessel that is supposed to answer the purpose of a heart, though it is not in the least like one. It has been seen to beat, but nothing very clear is known about it.

The caterpillar, in proportion to its size, is a great deal stronger than either you or I. And this is because of its very powerful muscles. It has more than four thousand of them; and they run lengthways, and crossways, and form a complete network beneath its skin, like a pattern of fine lace. They enable it to bend about, and put itself into all manner of attitudes; and also to lift weights much heavier than itself.

There is a story told of a large caterpillar* that was once caught, and put under a bell-glass to be safe. The glass was ten times heavier than the caterpillar, but by the aid of its powerful muscles, it lifted it up with ease, and was making its escape. Again it was taken prisoner, and placed under the glass, and this time a great book was laid on the glass in order to keep it down. You would have thought that the caterpillar was quite secure now, but no such thing. It crawled round and round its prison; and then, as if gathering up

* Of the Goat Moth. Cossus ligniperda.

its strength, thrust its head under the edge of the glass. In another minute, it had lifted it up, thrown down the book, and fairly gained its liberty.

So much for the muscular strength of the caterpillar. And now let us say something of the hairs that often grow upon its body.

You all know the hairy caterpillar that is found so plentifully in our woods and lanes. Its long silky hairs help to defend it from its enemies; for if you touch it, it instantly coils itself round like a ball, and drops to the ground. There it is cunning enough to lie quite still, hidden by the grass, so that it is not easy to find it; and even if you do, its smooth hairy body will slip through your fingers like an eel. This caterpillar wears its shaggy coat even to the tips of its feet, and no doubt finds it very comfortable. It does not go into a torpid state in the winter, and as it eats grass, it can always find plenty of food. On a fine day, when the sun happens to shine, numbers of these caterpillars come out to enjoy it; and you may see them stretched on some withered twig, making the most of the gleam of warmth and brightness. The moth is called "Drinker Moth,"* because the caterpillar has been seen to

* Bombyx potatoria, from *potare*, to drink.

drink, and then hold up its head to let the water run down its throat, like a hen.

When a hairy caterpillar was seen to run over the snow, it used to be regarded as a sign that the following summer would be cold and ungenial, and the harvest sure to fail. But the sign has so often been proved untrue, that we hope no one is credulous enough to believe it.

The fine hairs with which some caterpillars are clothed, have the disagreeable property of irritating the skin, as if you had touched a nettle. In hot countries, they sting much more sharply than they do here, and it is hardly safe to handle them.

Réaumur, the famous naturalist, speaks very feelingly on the subject. When he was travelling in America, he took up a caterpillar that was covered with hair. The hairs instantly ran into his fingers, and made them smart and swell; and as he was unlucky enough to touch his face, that inflamed and smarted too; and his eyes were completely swelled up. Some ladies were with him, who took care not to meddle with the caterpillar; but they did not escape much better. The fine hairs that were floating about in the air, penetrated their skins, and stung them almost as sharply.

Another American caterpillar * has four knobs, of a red colour, growing on the front, and four on the hinder part of its body. When it is touched, it opens these knobs, and darts out several bunches of little stings. The wound they inflict is very painful, and quite enough to keep its enemies at a respectful distance.

Caterpillar of Doratifera vulnerans.

* Doratifera vulnerans.

In many of the towns of India and Ceylon, long lines of trees have been planted in the streets, and their broad leaves afford a refreshing shade and coolness.

This would be all very pleasant, but there is a drawback, in the shape of a hairy caterpillar, who, with hundreds of its kind, live in the trees, clinging to the branches and the bark. When they want to change into the chrysalis state, they descend to the ground, by means of their silken threads. And woe be to the unfortunate lounger on whom they chance to alight! If he tries to brush them off, they sting with such fury, that the pain is not soon forgotten.

The pest of these caterpillars is so great, that, every now and then, men are employed to singe them off the trees, by raising torches on the top of poles, and so burning them out of their homes. They fall to the ground in immense numbers, and are picked up and eaten by the crows and other birds. Thus, for a time at least, the nuisance is abated.

But instead of soft hairs, some caterpillars are provided with spines or bristles that are sharp enough to prick you. One caterpillar that is very common, of a black color dotted with white, has three spines, and they are very hard and stubborn. The robins, and other little birds, are

careful not to pounce upon the bristly caterpillars, but to choose those with soft smooth bodies. In hot countries, the spines are much stiffer and stronger than they ever are here, and some of these creatures look very formidable.

There is one* that bears the ugly nick-name of "the Hickory-horned devil;" though in reality it can do no one any harm. It lives in America, and feeds on the leaves of the walnut and hickory-nut tree. The common people are as much frightened at it as they are at the rattle-snake, and run away the moment they see it. A traveller once took a great deal of trouble to explain how harmless it was, and even held it in his hand, and tried to persuade them to touch it. But they all shrank back in alarm and would not come near it. Their cry was, "It will not hurt you, but it would sting us to death!"

I think if you were to meet with this queer-looking creature for the first time, you would be alarmed too. It is about the length of your hand, and very thick, and of a yellow-green color. Each of its rings has a few black spines upon it, but the most formidable part is the neck and head. For there the spines are very long and fierce-looking; and when it is disturbed, it has a way of raising its head, and setting them

* Of the moth Bombyx regalis.

up like a crest. And besides this, it shakes its head from side to side, as if it were going to dart

Head of the "Hickory-horned devil."

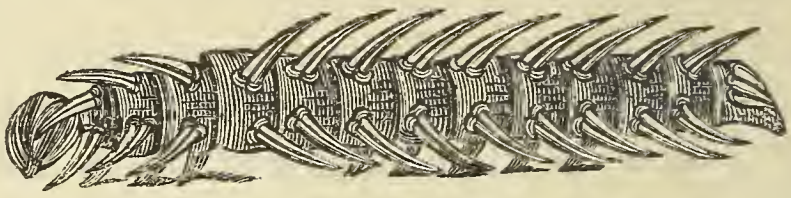
upon you; but it is a false alarm, for it will do nothing of the kind. When the caterpillar changes its skin for the last time, the crest of horns falls off along with it.

I must now tell you something about a caterpillar changing its skin. If you were to pull a rose-bud to pieces, you would find that it is

composed of a number of leaves folded one within the other. The outer leaf is hard and horny from exposure to the air, but the inner ones are quite soft and pulpy. After a time, the inner leaves grow larger and stronger, and spread out into the flower; but the outer leaf remains the same, and being a mere sheath, is often cast off as useless.

Very much the same thing happens in the case of the caterpillar. It has several skins, one within the other; the inner ones soft and delicate, and the outer one hard, by exposure to the air. The caterpillar grows very fast, but the outer skin does not keep pace with it. It is like the sheath of the flower, and has to burst and let the next skin come to light. When this is going to happen, the caterpillar leaves off eating; for there is no room in the tight old skin to hold any more food. It begins to be uncomfortable, and wriggles itself about, as if it were in a strait waistcoat. At length, it makes a slit, generally behind the head, and forces itself through the rent, drawing out its feet as if it were drawing them out of a glove. It comes out very damp, and if it is a hairy caterpillar, there will be new hairs upon the new skin, lying folded down like little wet tufts. But the hairs and the skin soon get dry, and the creature looks much fresher and brighter than it did before. It is more hungry

than ever, and eats and grows until very soon the new skin becomes too tight, and has, in its turn, to be cast off in the same manner as the old one.



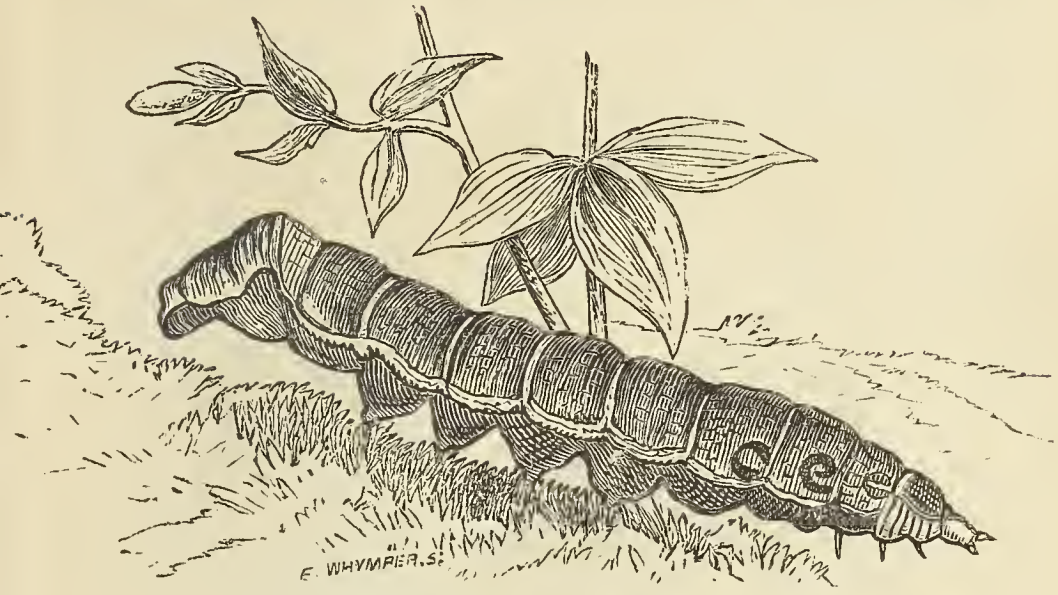
Caterpillar with its hair wet.

But before dismissing the caterpillar's skin, I might notice that its colors are very various; and that the prettiest caterpillar often produces the most dingy-looking moth, while a plain caterpillar not unfrequently comes out a brilliant butterfly. The body of the caterpillar also varies in shape, according to the species. In some cases it tapers off at both ends, and in others only at one.

In some caterpillars the head will taper off so very much as to be a little like the snout of a pig, and on this account, they are called by the French "*Chenilles cochonnes.*" Others taper off at the tail, which is so sharp as to resemble the tail of a fish, and they have been described as "*Chenilles en forme de poisson.*"

During the winter, many caterpillars lie in a torpid state. When there are no leaves on the trees, the earth is a barren desert to them, and

they must fast until the spring comes round. It is therefore wisely ordained that they should

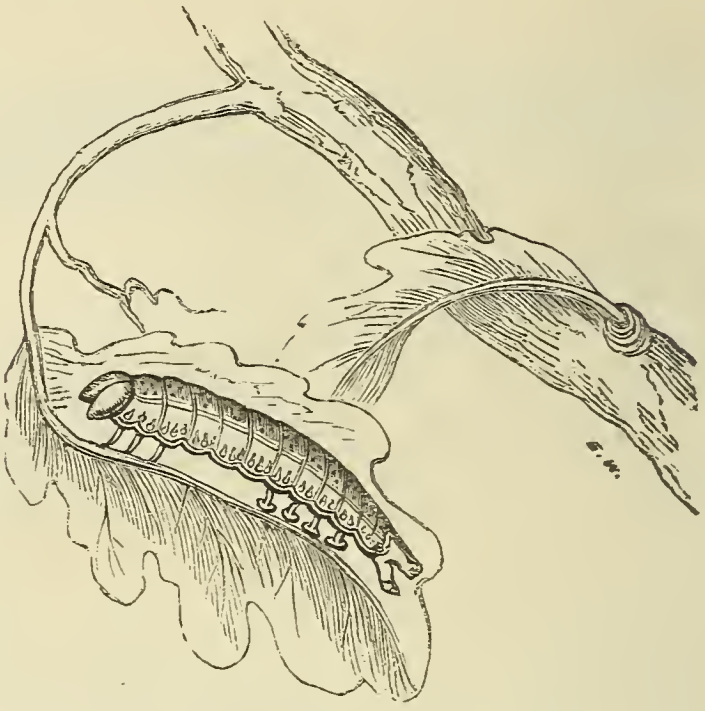


Pig-snouted Caterpillar.

pass the time in sleep; and accordingly they disappear, and remain hidden, either in their winter nests, or in some warm and sheltered spot.

They are able to resist a great amount of cold; but should the frost be very intense, they are frozen like everything else. Such however is their tenacity of life, that they have been known to revive even after this has happened to them. A number of caterpillars, that were frozen so hard as to chink like stones, were once dropped into a glass, and brought indoors. The warm room thawed them, and they lived and moved just the same as ever!

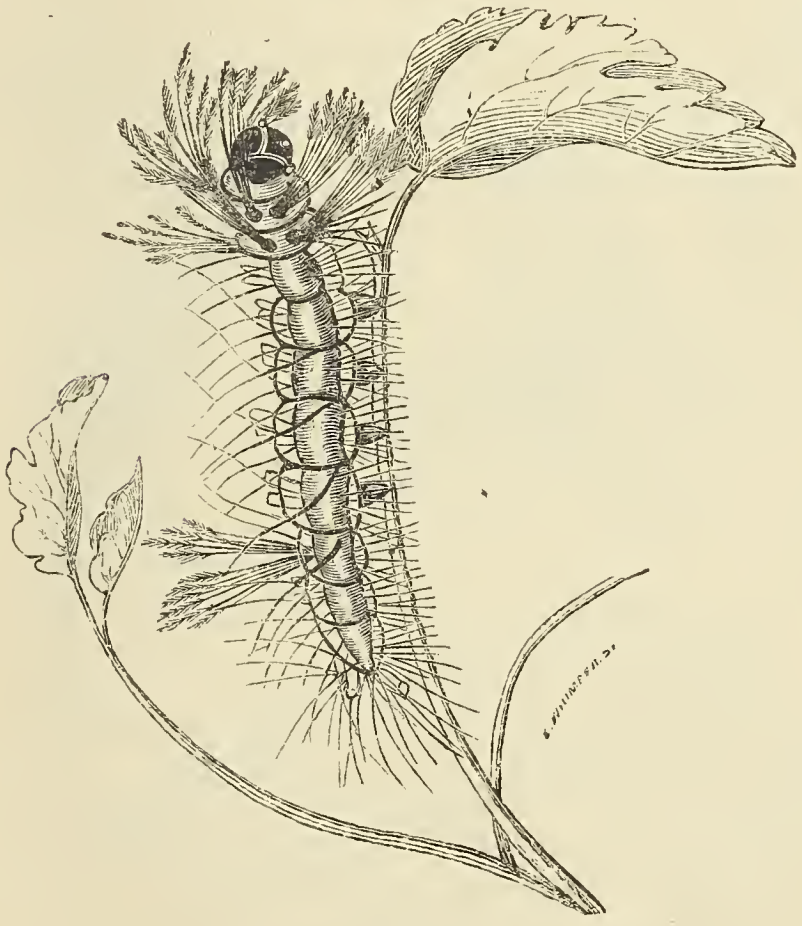
In this climate there are mild days every now and then in winter, and then the caterpillars will



Fish-shaped Caterpillar.

wake up, and even venture out of their nests. But the cold wind soon sends them back again to finish their sleep; and it is not until the spring that they thoroughly revive. Then out comes, first one and then another, just as is most convenient for it. The one that feeds upon the plaintain is out in March, for the plant is ready for it. But those that eat the leaves of trees sleep a little longer, for no tree is bold enough to put forth its foliage so soon. But the warm

breezes, and genial sunshine, tempt Nature to put on her robe of green, and every living creature rejoices in the return of plenty. Then, there is not a sluggard to be found; all are awake, and the busy throng of insects swarm round us, and, countless as are their numbers, find their wants abundantly supplied. "He openeth His liberal hand, and satisfieth the desire of every living thing."



CHAPTER THE THIRD.

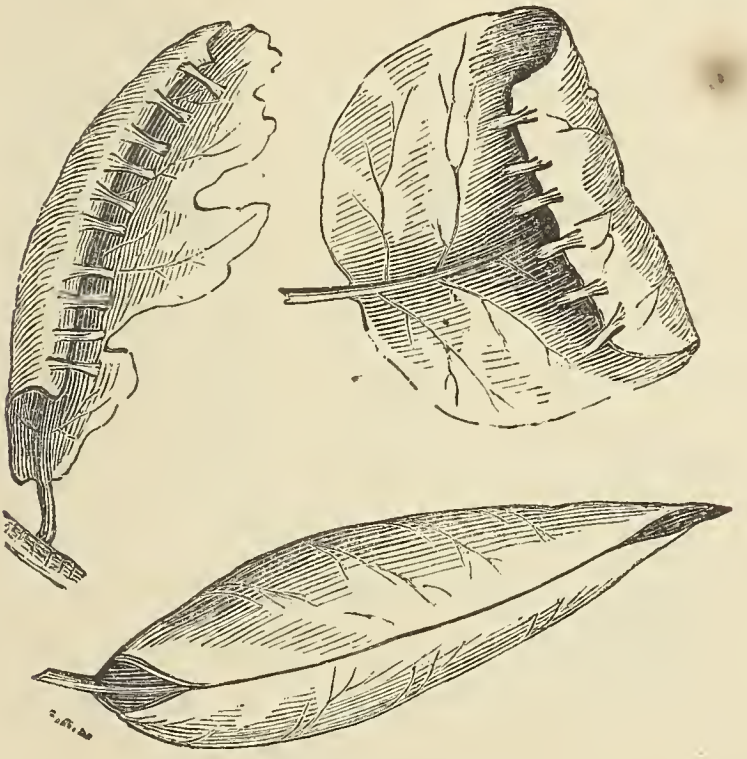
SOLITARY NESTS.

If you could be gifted with the power of seeing all that is going on in the animal world, and were to look round you, one fine summer morning, what a busy scene would be spread out before your eyes!

Every creature is at work. The busy bee, humming from flower to flower, knows that its home is in the hive yonder, and is bestirring itself to lay up a store of honey there for the winter. The wasp is gathering materials for his paper nest, that you may find in the wood hard by. The ants are running in and out of their long galleries; the beetles are clearing away rubbish, or burying some dead insect; the gnat is building her raft of eggs upon the brook; and the spider is throwing her silken thread from one blade of grass to the other. Our friends the

caterpillars are hard at work too, and we will take a peep at what they are doing.

There is a caterpillar* on the leaf of the lilac tree. How busy it is! We may go close up without fear of disturbing it, so intent is it on what it is about. It belongs to the solitary species, and is going to make a snug little cell, where it may live all by itself. It will begin by joining the edges of the leaf together, and this is no easy matter, for it has no fingers to work with, and the leaf is very elastic, and apt to spring back again. But the caterpillar knows how



Leaves rolled.

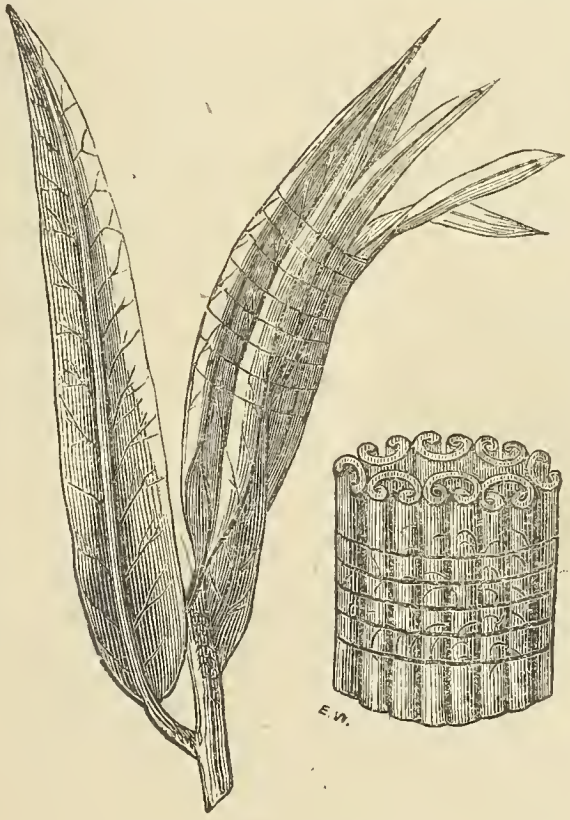
* Tinea and tortrix, are leaf-rollers.

to manage better than either you or I do. It fixes its silken threads from one side of the leaf to the other, and then going to the middle, pulls the threads tight by bending them with its feet, until the edges of the leaf touch each other. Then it glues the threads down, so as to prevent the leaf starting back. Thus while we have been looking at it, it has made itself a nest, where it may live undisturbed; for the mother moth has only laid one egg upon the leaf. It will feed in its little green gallery, hidden from the birds that are hopping about, and ready, the moment they see it, to snap it up.

There is another caterpillar on the lilac-tree, but it proceeds in rather a different manner. Instead of drawing the two edges of the leaf together, it begins at the tip of the leaf, and rolls it round and round like a piece of parchment. It manages this as its neighbour did, by means of its silken threads, firmly fixed from the end of the leaf to the middle vein. After it has fixed one thread, it draws it towards itself by the hooks of its feet, and then spins another shorter thread, which it again pulls tight, until the leaf begins to roll. It goes on in this way for some time, and then spins a second set of threads, fixing them much further back upon the bent part of the leaf, so that the leaf is again rolled round.

When it has rolled it enough, it weaves a few thicker threads on the outside, so thick that they may be compared to cables, and fixes them to the part of the leaf that is not bent, just as we fasten ropes to the canvass of a tent, and then peg them to the ground. Thus it is quite impossible for the leaf to unroll itself.

And now let us step into that plantation, and see what is going on amongst the osiers. Do you notice how curiously the long narrow leaves of the willow are tied together? If we pulled them open, we should find a caterpillar inside.



Willow leaves tied.

It has wrapped two or three leaves together, by winding its silken threads round and round them, and has left a passage within, large enough to live in, and where it can go up and down at pleasure.

The soft silky catkins of the willow have furnished another little caterpillar with the means of making its nest. It works its way into the seed, surrounded as it is with long down; and then loosening it from the stalk, carries it off as a moveable tent. It is called a muff tent, because the shaggy down of the seed looks a little like fur.

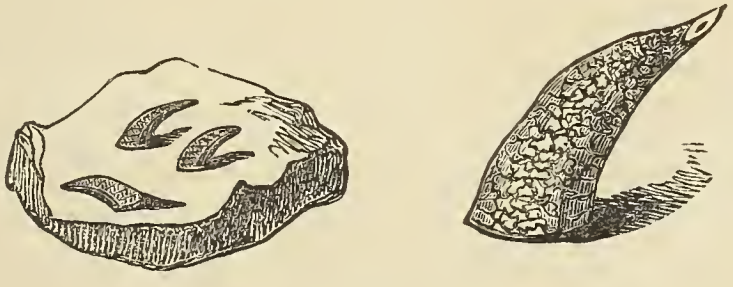
If you were to gather a handful of moss from the top of an old wall, you would be almost certain to find amongst it the tiny nest of a caterpillar.* It has gnawed the leaves and branches of the green moss into little pieces, and arranged them so as to form the inside of its nest; while the bits of earth, that were hanging from the rootlets of the moss, have been arranged on the outside, and form the outer wall. But so well has the caterpillar contrived, that

Moss nest.

* Pontia rapæ.

its house looks only like a tuft of moss, growing a little higher than its neighbours.

Here is another caterpillar* on the same old wall. It is a very common caterpillar indeed, but so small as to be often over-looked; and it builds for itself a moveable tent of a curious kind. It detaches from the wall first one atom of stone and then another, and fastens them together with its gummy silk, until it has raised itself a tent big enough to live in. The tent is a little the shape of a horn, and comes to a point at the top, where it is left open to admit the air; but the opening is well protected by a web, so that no insect can get in. The caterpillar carries its tent about with it on its back, as the snail does its shell, until it is ready to change into a chrysalis. Then it fastens it securely down to the stone, spinning a thick curtain to close up every aperture; and when the moth is ready to come out, she breaks through the top of the horn.



Stone tents. Natural size and magnified.

* Genus tinea.

These little caterpillars were once thought to eat stone, because they were seen with bits of it in their mouths. But a naturalist made sure this was not the case, for he watched the whole process of making the tent, and found that it took the caterpillar twenty-four hours to finish it.

If you gather a leaf from the pear-tree, and look upon the under side, you will be almost sure to find some downy russet-coloured spots, not thicker than a pin, and about a quarter of an inch high. You would never guess that these were tents of caterpillars, but such they are; and if you give one of them a gentle squeeze, out will come a little yellow caterpillar to see what is the matter. It eats the pulp of the leaf quite away in a circle under its tent, and leaves nothing but the thin membrane. When there is no more food to be had in one place, it will take up its tent and carry it to another; until at last the leaf is covered over with withered specks, the consequence of its former meals.

The tent itself is made of silk, spun by the caterpillar as soon as it comes out of its egg. But the little inmate eats and grows every hour of the day, and as a natural consequence, its house very soon gets too small for it. The only remedy for the evil is to make it bigger, and this the caterpillar does in a most inge-

nious manner. It slits the tent in two, and joins in a fresh piece, so as to allow itself plenty of room. It has taken care to fasten the tent down by cords, lest the wind should blow it over; and when it wishes to move, it gnaws the cords asunder, for it can spin new ones without any difficulty. So on it goes, eating, growing, and moving, until its caterpillar life is ended.

There is a little neighbour of this caterpillar, that lives upon the leaf of the rose-tree. It does not build a tent, but it works its way between the membranes of the leaf, where it lives quite hidden from sight, and eats the pulp as it goes. You may trace its course by the marks and lines it has made in its wanderings, and that wind about as a river does upon a map. This little miner began to dig into the leaf, the moment it was hatched; and seemed afraid of moving a hair's breadth from the spot, lest it might fall into danger. In course of time it will change into a moth,* so extremely small as to pass unnoticed; but if you looked at it under a microscope, you would be astonished at the brilliance of its colours. Even the humming-bird of the tropics can hardly compare with it, and it has been called a little miracle of nature. Gold, silver, and pearl are lavished upon it; and so splendid are its tints,

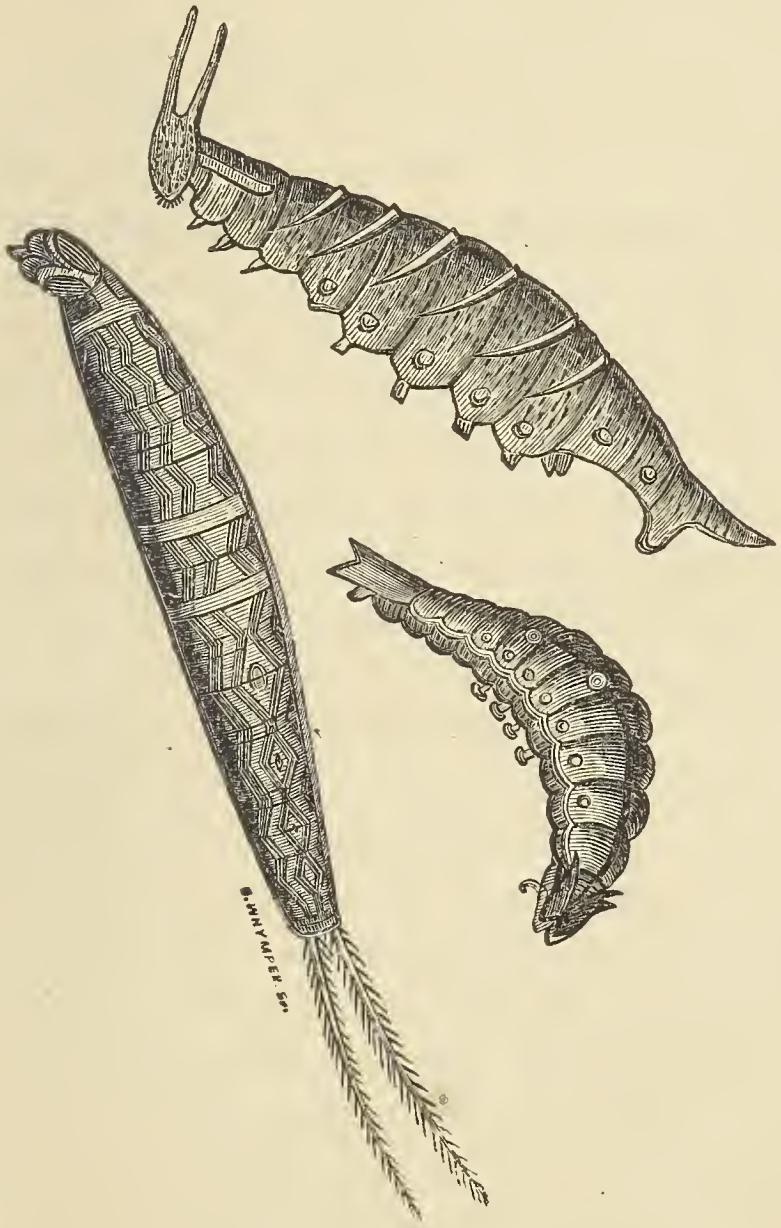
* Of the genus Tinea.

that were it only larger, it would bear away the palm of beauty from the insect world.

But I must tell you a curious stratagem that another, and much larger caterpillar* employs to secure itself from its enemies. It lives in New Holland, and is hatched upon the bark of a tree. The moment it comes out of the egg, it begins to bore downwards into the wood, and goes on until it has reached the very centre of the stem. Here it makes a cell, and takes up its abode. But it dares not leave the entrance of the hole undefended; so it weaves a door of silk mixed with bits of stick and leaves, in such an artful manner that it can hardly be distinguished from the trunk. The door is fastened at the top, but swings loose below, so that the caterpillar can push its way in and out. All day, it lies snug in its nest; but when the sun has set, it sallies forth to search for food. Presently it comes back, holding a leaf by the end of the stalk, dragging it along. To open the door is rather a difficult matter, since the caterpillar has the leaf in its mouth; but it pushes it open with the hinder part of its body, and slides in backwards, drawing the leaf after it; nor does it quit its hold, until it has safely gummed the leaf within the cell. Then it sets off in quest of

* Nycterobius, is very destructive to the Banksia trees.

more, and goes on working all the night. But when daylight dawns, it hurries back to its cell, and shuts itself up to feast on the abundant store it has provided.



Foreign caterpillars of curious shapes.

CHAPTER THE FOURTH.

SOCIAL NESTS.

The caterpillars noticed in the last chapter are all hermits, and live alone. We will now find some that choose to live in colonies, and have but one house amongst them. And we shall not have far to look. In every garden, the apple-trees are disfigured, here and there, with what you think are spiders webs; but if you examine them more closely, you will see that they are full of caterpillars.

Nothing can be more luxurious than the life these little creatures lead. They have made themselves a kind of hammock, on which they recline at their ease; and when they are hungry, they put their heads over the side, and eat the leaves that surround them, without taking the trouble of moving. If you touch them ever so slightly, they will draw back as if it were very disagreeable to them indeed. But this movement of drawing back is always made in a straight line, without turning to the right or to

the left; and if you looked at them through a glass, you would see the reason. Each caterpillar is inclosed in a sheath of net-work, so delicate that the naked eye cannot see it. Thus they are not only housed, but clothed in silk. In the course of their lives, the caterpillars make seven or eight of these hammocks; for when they have eaten up all the leaves round them, they are obliged to move, and spin a tent somewhere else. You may easily imagine that the poor apple-tree is greatly the sufferer from their appetites.

But you remember the gold-tail moth, that plucked the down off her body to protect her eggs. Her eggs have now come into caterpillars, and the first that is hatched begins as a matter of course to eat. Then out comes another, and places itself on the leaf by its side. By and bye a third is added, and so on, until a row is formed from one side of the leaf to the other. A second row is then begun behind the first, and after this is completed, a third, till the whole surface of the leaf is covered with rows of caterpillars.

But a single leaf will not contain all the family, and the rest have to take up their places on the neighbouring leaves. They eat voraciously, and with as much regularity as if they were executing a military manœuvre. But they take

care to eat the leaf only half-way through, so as to leave the nerves and thin membrane untouched; for these are to form the canvas and cordage of their future tent. When their hunger is a little appeased, they begin to be very busy. You may see them carrying their lines of silk from one side of the leaf to the other, and drawing it into a concave shape. They go on adding thread to thread, until what at first was a slight web becomes a thick veil of brilliant whiteness.

All the leaves on which they have fixed themselves are roofed over in this manner; and here the little colony reside during the summer, and make excursions in search of food. But autumn comes, and the chilling wind begins to whistle through the tree; it is time for them to make a warmer and a safer dwelling, and they set about it accordingly. They are now grown much bigger and stronger, and they stretch their thick threads from twig to twig, and inclose a space, sufficiently large to hold them all. The whole family work with great energy at this new tent, which looks, when it is done, like a packet of silk and leaves rudely woven together, and of no particular shape. But it is very comfortable within, and is divided into a number of apartments, each large enough to hold several caterpillars. The apartments

form such a complete labyrinth, you would wonder how those that live in the middle can ever find their right quarters. But passages are made, and left open in order to guide them and prevent any confusion. Here they live all winter, and in the spring they resume their active habits, and make excursions in search of food. But however far they may ramble, there is no fear of losing themselves. Each caterpillar weaves a thread as it goes, so that their paths may be said to be carpetted with silk. In the summer the colony breaks up, and the caterpillars seek, each one, a retired spot, where it undergoes its change into a chrysalis state.

But we can find another colony of caterpillars* if we look in the meadows. They feed on the plaintain, and unite in drawing the leaves together, and making a nest as much the shape of a tent as the grass will let them. It too, might be taken for a spider's web; and like the other, is divided into a number of apartments, that are added one after the other as the caterpillars get larger. When the colony has eaten up all the tender leaves beneath the awning, it abandons that place, and weaves a new tent in another. Thus the caterpillars are a little like the wandering Arab, who strikes his tent as

* Melitea cinxia.

soon as his cattle have eaten up the grass round it, and goes in search of fresh pasture.

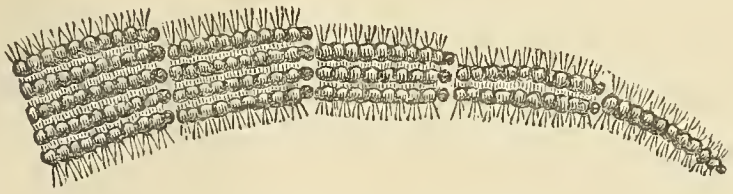
In summer, the web of the tent is so fine as to be transparent; but before the winter comes, the caterpillars spin more threads, and make them into a round ball, thick and strong, so that you cannot see through it. Here they coil themselves up, and lie huddled together in one apartment, waiting for warmer days, and brighter weather.

But you will be most interested to hear about the processionary caterpillars.* They are natives of France, and feed upon the oak. Their nest is always found upon the trunk, and as the silk it is made of is of a grey colour, it looks, at a distance, like a mass of lichen.

There are about eight hundred caterpillars in a family; and while they are young they have no fixed habitation, but encamp sometimes in one place, and sometimes in another. As soon however as they are grown up, they weave a tent in common, and leave a single opening, that serves them for a door. After sunset, they march out with such regularity, that they are like a troop of soldiers. The one that is nearest the door goes first, and heads the procession. When he stops they all stop, and when he goes on they all go on. He is followed by three or four cater-

* Bombyx processionale.

pillars in single file, the head of the second touching the tail of the first; then come an equal number of caterpillars marching in pairs, then of three marching abreast, and so on as far as twenty. They move regularly on at an even pace, each file treading on the steps of the one before it.



Caterpillars in procession.

It is a beautiful sight to watch some species of these processionary caterpillars on their march. They wind gracefully about, looking like a cord of gold, upon a ribbon of dazzling whiteness. The golden cord is the bodies of the caterpillars, that are of a brilliant yellow, and the ribbon is the silken carpet they spread as they go along; for these dainty creatures will not condescend to touch the ground with their feet. Like kings and emperors, they must tread upon a tapestry of silk.

But the most elegant nest is that which hangs from the branch of a tree, suspended by a strong silken cord. It is made of one or two leaves neatly folded and joined together with silk, and

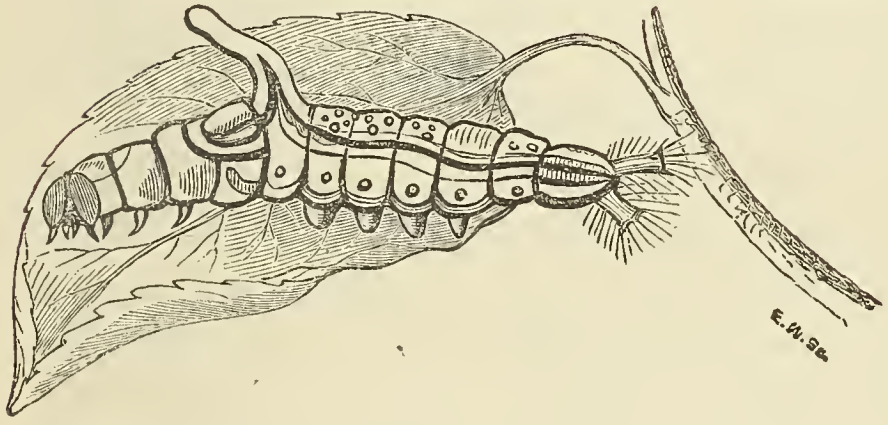
within, a family of caterpillars live in great harmony. A traveller in Mexico was going up the mountains, and came to the region of oaks, and tall majestic trees. To his surprise he saw innumerable white paper bags, as he thought them, hanging from the branches. He pulled one down, and found it was a caterpillar's nest, made of silk, and so strong that it was with some difficulty he tore it open. It was full of caterpillars, and contained besides a quantity of green leaves, on which they were feeding.

Common leaf nests in England.

Another traveller observed these hanging nests, and they looked so white and dazzling, he fancied they were made of Chinese paper. They were however composed of silk, spun by the caterpillars, in layers, one within the other; the outer layers very thick, and the inner ones exquisitely fine and transparent.

You may suppose that the silk is too good to be wasted, and the natives use it for a variety of purposes. They make handkerchiefs and stockings of it; and besides that, they take the

inside layers, that are so fine and transparent, and paste them together to form writing paper. This was done so long ago as the time of Montezuma, the last, and unfortunate emperor of Mexico.



CHAPTER THE FIFTH.

THE MISCHIEF CATERPILLARS CAN DO.

When you think of the millions of caterpillars that come out of their eggs every spring, and what an enormous appetite each caterpillar has, you will hardly wonder that, every now and then, they should be almost as destructive as the locust. Were it not for a tribe of enemies, amongst which are the birds, the wasps, and the ichneumon flies, we should find them sad pests to our orchards and gardens. As it is, with all these enemies to wage war upon them, they often do us a great deal of mischief.

Once upon a time, a wood in Kent presented a very strange appearance. In the month of June, when the trees, in every other place, were in full beauty, in this wood there was not a leaf to be seen; nothing on every side met the eye but bare branches, as though it were the depth of winter. The people, who lived near,

thought it must be blight; but some naturalists took the trouble to visit the wood, and they said it was not blight, but caterpillars.* Caterpillars are little creatures to do such a large amount of mischief; but thousands upon thousands of them had been feeding, day and night, on the trees in this wood, and the consequence was they had eaten up all the leaves, and left nothing but bare branches.

I will tell you another such instance. One summer, some years ago, an army of caterpillars† suddenly made their appearance in the neighbourhood of London; and began to march through the country, devouring everything before them. The trees swarmed with them, the gardens were stripped, and scarcely a green herb was to be seen upon their track. People fancied the very air smelt of caterpillars; they raised an alarm that the plague was sure to follow; and in order to avert such a calamity, prayers were put up in the different churches. The poor market gardeners suffered the most, and subscriptions were raised to assist them; and persons were paid to collect the caterpillars' webs, and burn them. The churchwardens, in many of the parishes, gave a shilling for every bushel of web that was

* Of the moth Tortrix viridiana.

† Of the brown-tail moth, Porthesia auriflua.

brought, and as much as eighty bushels were burnt in one day.

In France, a similar misfortune happened, in the year seventeen hundred and thirty-one. A traveller was going from Paris to Tours, and to his surprise the trees all looked as if some hot wind had scorched them. But it was no hot wind; they were literally swarming with caterpillars. And by and bye he saw these voracious little creatures march across the road in a regular army, to get from one field to another, intent on devouring every green thing they met with.

The government passed a law bidding the people uncaterpillar (*decheniller*) the trees. But it was an impossible task; for the caterpillars were like the sand of the sea for multitude. The worst part of the story was, that the people fancied they were poisonous, and would poison every thing they touched. So in consequence of this idle tale, the few vegetables left, were not allowed to come into the market. Fortunately the caterpillars did not touch the corn, or there must have been a famine. At last, a number of cold wet days thinned their ranks; they died by thousands, and in a short time scarcely one of them was to be seen.

But you must not suppose that all caterpillars feed upon green leaves, and soft substances;

there are some that eat the woody fibre of the tree itself. I have already mentioned the caterpillar of the goat moth,* that was strong enough to lift the bell-glass, with the heavy book at the top. It lives in the inside of trees, and gnaws its way to the very core, in order to make itself a nest. Here it scoops out a hollow place, just large enough for it to lie in; and lines it with a substance as thick and warm as cloth, made of the raspings of the wood, joined together with silk. During the cold of winter, it remains in a torpid state, snugly housed within its comfortable nest. These caterpillars do a great deal of damage to the trees, and will often cause the stoutest timber to decay.

The owner of an estate once observed a fine old elm, that had braved many a severe winter, begin to look unhealthy, and to lose the colour of its leaves. The tree kept getting worse; and no one could imagine what was the matter with it, until, one day, a caterpillar was seen to put its large scaly head out of a hole in the bark. The cause of the mischief was explained; the tree was evidently infested with caterpillars, and to prevent them getting into the neighbouring trees, the only thing to be done was to cut it down!

* Cossus ligniperda.

Some caterpillars* are very fond of fruit, and one is called "The Pest of Pomona." Pomona is, as you know, the goddess of fruit; and it is in her dominions that the tiny ravager commits its depredations. It feeds upon the lovely blossoms of the apple and the pear, and prevents them ever coming to perfection. Even the apples themselves are not safe; for a caterpillar will make its nest in the pippin, and if you cut the apple open, you would find it unsound.

Often an apricot falls from the tree, before it is ripe; and when this is the case, there is pretty sure to be a caterpillar feasting on the kernel.

In North America, peaches and apricots are much more abundant, than they are here. Their juice is distilled into a spirit, and swine are fed upon the fruit. The failure of the crop is a serious matter; but it sometimes happens through the ravages of the caterpillar.

Nor do the beautiful vineyards of France escape. One caterpillar lives upon the leaves of the vine; another species weaves a web so closely round the bunches of young grapes, that they cannot swell or grow; and as if this were not enough, a third attacks the grapes themselves.

Often, too, when the chesnut-trees are loaded with fruit, and promise an abundant harvest, the

* Tinea, several species.

chesnuts will begin to fall before they are ripe, and go on falling, until the trees are left quite stripped. This is a sad disappointment to the grower, who knows very well that the caterpillars have been busy feasting on the inside of the chesnuts.

Even the date, that has the hardest stone of any fruit in the world, is not free. The caterpillar, with its strong jaws, will gnaw into its core, and carry on its depredations. But when the little creature is about to change into a chrysalis, it works its way out of the kernel, and undergoes the change between the stone and the pulp, so that the moth may have no difficulty in making her escape.

The olive-tree is the greatest blessing to the inhabitants of the south of Europe, on account of the oil that it yields. But the olive will, occasionally, cast its fruit in the same way as the chesnut, and from the same reason.

Amongst the many severe judgments with which the Jews were threatened, in case of their disobedience, was this failure of the olive and the vine. "Thou shalt plant vineyards and dress them, but shalt neither drink of the wine, nor gather the grapes; for the worms shall eat them." "Thou shalt have olive-trees throughout all thy coasts, but thou shalt not anoint

thyself with the oil; for thine olive shall cast his fruit."

But to return to our own country. Perhaps one of the most destructive creatures living is the caterpillar of the clothes moth,* for it not only eats, but actually makes its garment out of our cloaks, and furs, and woollens; and leaves, in its track, a gnawed and worn-out pathway, that will hardly bear touching. It mows down the hairs of the fur or cloth, with its tiny jaws; and gumming them together, makes a coat that exactly fits it, and is like a case open at both ends. But as the caterpillar grows, its coat gets too small, and it has to make it larger. Accordingly, it slits it up, and works in a fresh piece, just as much as is wanted, and this it does as skilfully as any tailor. It is careful not to make the slit all at once, from one end to the other of its case, lest the tiny garment should fall in two, and leave it exposed. So, as if the caterpillar reasoned on the matter, it first slits one side half way up, and fills it in, and then the other side in the same way, and fills that in also. So that in fact it has four seams to sew.

If you moved one of these caterpillars from one piece of cloth to another of a different color, and then on to another still, its coat would look

* Genus Tinea.

like patchwork, as it would have cut down the hairs from each cloth, and worked them in.

Museums are often very much injured by the caterpillar of the clothes moth; which will take up its abode in stuffed birds, and every kind of insect, from a butterfly to a beetle.

Another caterpillar, of the same family*, devours corn that is stored up in granaries. It is so scarce in England that it cannot do much harm; but on the Continent, where it abounds, it often does a great deal of mischief, and causes some alarm. It has a curious way of tying several grains together; and then lives in the middle, as in a little tunnel, out of which it can put its head, and feed.

One of these corn-eating caterpillars has rather a different way of proceeding. The mother moth lays about twenty eggs at once; but as soon as the caterpillars make their appearance they divide, and each one chooses a separate grain to live in. It makes its way into the heart of the grain; taking care not to gnaw or disfigure the skin, so that the farmer thinks all is safe, for he cannot see the tiny hole, by which the caterpillar has crept in. But he will find out his mistake by and bye; for the destructive little

* Tinea granella.

creature has eaten up the inside of the grain, and left nothing but the skin.

The stores of the industrious bee do not escape any more than the farmer's granary. The caterpillars will make their way even here, and commit great havoc. You would wonder how the mother moth* could contrive to lay her eggs in the hive; for the bee sentinels are always on the watch, with their feelers extended, ready to sting any intruder to death. But instinct impels her to do it, let the danger be what it may, since she knows the only suitable food, for her young, is the very waxen comb so stoutly defended. She sets about her task dexterously, and as if aware of the risk she ran. When twilight comes, and the bees cannot see very clearly, in glides the moth; darting between them, with the utmost swiftness, and avoiding the slightest contact with their feelers. She is pretty sure to succeed in her undertaking, and after she has laid her eggs in the comb, she glides out again, in the same dexterous manner; leaving the poor bees unconscious of the enemy she has brought among them.

When the caterpillars are hatched, they begin to feed upon the waxen comb; making little holes in it, through which the honey flows out, and is

* Tinea mellonella.

wasted. They are as much exposed to the anger of the bees as their parent was; and to shelter themselves from their stings, they work up grains of wax, into hollow passages, and cover them with a web of silk. In these covered ways they lie secure; and pass, and repass, like rabbits in a warren. They work almost as hard as the bees do, and very soon their winding passages pierce through the comb in every direction.

The bees are constantly being entangled in the webs, as in a snare, and sticking fast by their wings or their legs. Indeed the annoyance becomes at last so intolerable, that they have been known to desert the hive, and seek another habitation.

Another little caterpillar is very fond of sugar; and as it lives in the West Indies, it is the pest of the sugar plantations. It bores into the foot-stalk of the leaf, and sucks away the sweet juice of the cane without killing it, or even spoiling its appearance. But the cane is useless, for it yields no sugar; and the planter dreads this minute enemy as much as he does the storms and hurricanes. His whole plantation will often be destroyed, and he himself entirely ruined.

I need not go on repeating instances, of the destructive habits of the caterpillar. I will only add, that in the hop-gardens of Kent and Essex,

the plants are very apt to wither, and droop their leaves. This is occasioned by the caterpillar of the "ghost moth," that has cunningly concealed itself at the root, and gnawed them until the young shoots are weakened, if not destroyed.

CHAPTER THE SIXTH.

ENEMIES OF THE CATERPILLAR.

It is a good thing for us, that the caterpillars have so many enemies to thin their numbers, and keep them within bounds. The birds that gladden our ears in spring, depend principally for their support on an abundant supply of caterpillars, and wage incessant war upon them. If the caterpillars were to fail, the birds would be very badly off indeed. One brood of sparrows will devour, it is said, as many as three thousand in a week. The cuckoo picks them off the leaf, one after the other, by dozens, and that in spite of all their contrivances to hide themselves. Even the great caterpillar is not safe in the heart of the tree. Every now and then, the woodpecker comes tapping with his long bill, and listens to hear if the wood sounds hollow. If it does, he knows his prey is within; and inserting his bill,

he picks it out and eats it. The woodpecker gets a bad character from this habit of his. Many people fancy that he is injuring the tree; instead of which, he is doing it good service, and freeing it from its enemies.

Then there is that handsome gaily-dressed fly, that looks very much like a wasp. You may see dozens of them on a hot summer day, flying to and fro in search of food, or buzzing in and out of little holes in the ground. These holes have been made by the industrious flies themselves; and here they lay their eggs, and also take the trouble to collect a supply of caterpillars, to serve as provender for their own little grubs to feed upon.

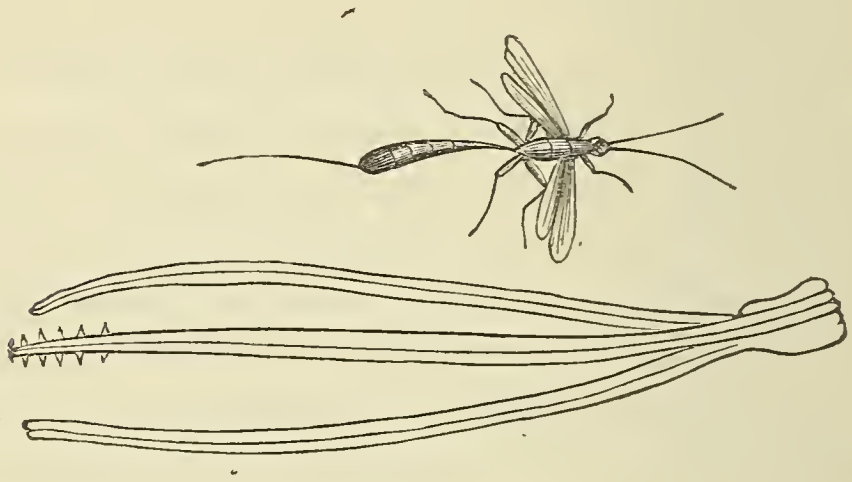
It is astonishing how hard they will work, led on by the instinct to provide for their young. You may see one of them scooping her hole out of the solid ground, and carrying away heavy loads of earth to a distance, lest they should roll back again. When she has finished, she lays her egg within the hole, and flies away in search of caterpillars. Often, you may see her dragging along a green caterpillar, three times as big as herself; and she will drag it too, a distance of several yards, a long way for such a heavy load. When she gets to her hole, she takes away the pellet of earth that was placed at the entrance, and

then descends, dragging the caterpillar after her. Having arranged it to her mind, she comes up again, and closes the door, pressing the earth down with her fore feet. She has been even seen to fetch a leaf or two and lay over the hole, as if to mark the spot.

But the most formidable enemy the caterpillar has, is a fly called the ichneumon fly. The name has been given to it, because it is as useful to us, in keeping down insects, as the animal ichneumon is to the Egyptians, in devouring the eggs and the young of the crocodile. The ichneumon was once believed to enter the crocodile's mouth, whenever it found one asleep; to go down its throat, and having killed it, to work its way out again. This is only a fable, but it is really a little like the manner in which the caterpillar is treated by the ichneumon fly; for she is always on the watch, not to eat it, but to lay her eggs in its body.

I must first of all tell you, that the ichneumon fly is furnished with a very sharp weapon, or borer, for the express purpose of making deep holes, in which to lay her eggs. The borer is sometimes longer than the fly herself, and is composed of three parts; the two outer ones being a mere sheath, and opening like a pair of compasses. The inner part, or the borer itself, is armed with

little teeth at the end, like a saw; and a hollow channel runs down it for the eggs to pass through. When it is shut up in its sheath, it looks only like a bristle coming out at the fly's tail.



Ichneumon fly. The borer magnified.

When the ichneumon fly is about to lay her eggs, she alights on the plant, where the caterpillar is likely to be found, and runs hither and thither examining every leaf. Presently, she espies her victim, and immediately perches herself on its back. Then she plunges her sharp weapon into its body, between one of its rings, and lays an egg in the hole. In a few seconds, she repeats the operation in a different place; always taking care to lay her eggs so deep, that the caterpillar cannot throw them off when it changes its skin. She is so intent on her work, that you might

stand by, and watch the whole process, without disturbing her.

The caterpillar does not to seem to mind it; though sometimes it will jerk itself about, and put out its horn as if to drive away its assailant. But the fly takes no notice, and goes on until she has laid all her eggs.

In process of time the eggs become little grubs; and begin at once to feed upon the caterpillar, and to work their way still deeper into its body. They take care, however, not to touch the vital parts, as if they knew that were the caterpillar to die, their supply of food would be cut off. So the caterpillar is not hurt, and goes on eating and moving about, as if nothing were the matter. But when the little grubs are fully grown, and want to get out, they gnaw their way through the caterpillar's skin; and then it dies, instead of changing into a chrysalis.

There are a great many species of ichneumon flies. Some are so small, that they lay their eggs in the egg of the butterfly; and others are so large, that a full-sized caterpillar can only nourish one of their grubs. One ichneumon lays her eggs, not within the caterpillar's body, but upon the outside of its skin; perching them on little footstalks, that are so firmly fixed, it is impossible to shake them off. When the eggs become grubs,

they still remain on their little stalks, and suck up the juices of the body through them, as through a tube. The caterpillar dies instead of becoming a chrysalis; but this does not matter to the grubs, as it is time for them to leave off eating, and become chrysalides themselves.

The caterpillar of the puss-moth is constantly attacked by the ichneumon fly; and its body will sometimes be completely studded over with these little footstalks. As if in compassion, Nature has given it a kind of whip, on purpose to drive them away. The whip is, in fact, a forked tail, com-

Puss-moth Caterpillar.

posed of two long tubes, and fringed with short, stiff spines.

If you were to touch the caterpillar, out would dart, from each of the tubes, a slender, rose-coloured organ, which it can turn and twist about, exactly as it likes, and with which it would lash the place where you had touched it. If an ichneumon fly settles on its back, it can sometimes drive it away; though such is the courage and perseverance of its enemy, that it will return again and again, and rarely give up its purpose.

Besides the whip, the caterpillar has another weapon of defence. It can dart from its neck a little organ, somewhat like a syringe, that is perforated with holes, in the same manner as the rose of a watering-pot. From this, it discharges a fluid to a considerable distance, that if it were to get into your eyes, would make them smart.

The caterpillar has a very defiant look, and sits with its head and neck held up, as if it did not care for anything. There is an amusing story told of a foreign naturalist, who saw it for the first time, and thinking it a curious creature, stretched out his hand to seize it. The caterpillar instantly bridled up its head, lashed its whip, darted out its syringe, and looked so threatening, that he was frightened, and thought he might be poisoned if he touched it. But

unwilling to lose the prize, he cut off the twig, and let both it, and the caterpillar, drop into a box he held beneath.

This same caterpillar spins a very strong cocoon for itself, when it is about to change into a chrysalis; and it was a matter of wonder, how the moth contrived to get out of it. Some said and it is now believed to be true, that she ejects an acid from her mouth, powerful enough to dissolve the wall of the cocoon, and make a passage for herself.

A gentleman wished to be quite sure of this, and kept the caterpillar in a box, that he might see the whole process. It generally makes its cocoon of the bark of a tree; but as no such material was to be had, it did the best it could under the circumstances. First of all, it spun a frame-work of silken threads, and then added more, and strengthened them by gluing them firmly together. It next began to gnaw bits of paper from the box, and fastened them into the meshes of its net; and went on working for half a day, until the whole web was so thickly studded with bits of paper, that you could not see through it. While it was wet, the fabric was soft, and might have been squeezed between the fingers; but as soon as the gummy matter, that fastened in the bits of paper, was

dry, it became so hard, a penknife could scarcely pierce it.

So far, all went well with the experiment. The caterpillar changed into a chrysalis within its strong walls; and by and bye, the moth was fully expected to come forth. But an inveterate enemy was at hand, in the shape of an ichneumon fly; whose sharp borer is able to pierce through the hardest substance. In an unlucky moment she penetrated the cocoon, notwithstanding its strength, and laid her eggs in the chrysalis. The poor chrysalis was devoured by the little grubs; who then went into the chrysalis state themselves; and instead of the puss-moth, out came an ichneumon fly. There were several others within the cocoon, but they could not make their way out, and so died.

The ichneumon is sometimes called the cuckoo fly; and with good reason, because, like the cuckoo, it does not trouble to make a nest of its own, but lays its eggs in those of its neighbours. I think I ought just to say, that the puss-moth is so named, because its body is thickly covered with down; a little like the fur of a cat.

Before I conclude this list of enemies, I might mention, that in New South Wales, the cater-

pillar has another foe, in the shape of an insect, called the "walking leaf." Its name is given to it, because it is just like a withered leaf to look at, and you might almost trample upon it by mistake. It hunts for the caterpillars, and devours them without any mercy, and they are obliged, as you have already heard, to shut themselves very closely into their nests, and only venture out at night.

The natives seem to have the same propensity for eating caterpillars, as the "walking leaf" has. They climb the trees, and take a great deal of trouble to find them, and esteem them quite a dainty morsel. Hundreds and thousands of caterpillars thus fall victims, to what appears to us a most unnatural taste.

But what is quite as curious, in New Zealand, the caterpillar is sometimes attacked by the tiny spores or seeds of a fungus; and they are as fatal to it as the eggs of the ichneumon fly, or any other of its enemies.

The caterpillar feeds upon a climbing shrub, and drops to the ground and buries itself in the earth, in order to undergo its change. But somehow or other, the tiny seeds of the fungus find their way into its body, where they take root and grow. So that instead of changing

into a chrysalis, the caterpillar itself becomes a chrysalis.

CHAPTER THE SEVENTH.

THE CHRYSALIS.

The use the little spinnaret is to the caterpillar must have struck you many times, while reading the previous chapters. We have seen how it has been enabled, by its silken thread, to make itself either a solitary dwelling, or to rear a tent, where it may live, with others of its kind. Without this precious boon it could neither roll the leaf, nor draw the blades of grass together, nor weave the thick curtain of its winter nest. Nor could it so readily climb from branch to branch. The silken thread affords it a rope-ladder, that can be brought out at a moment's notice, and on which it may go up and down whenever it likes.

And by means of this rope-ladder it often escapes from danger. As, for instance, there may chance to come a violent gust of wind, and blow the caterpillar from its leaf; but on the first alarm the little spinnaret is set in motion, and the

caterpillar spins a cable of silk that breaks its fall, and enables it to climb up to its place again.

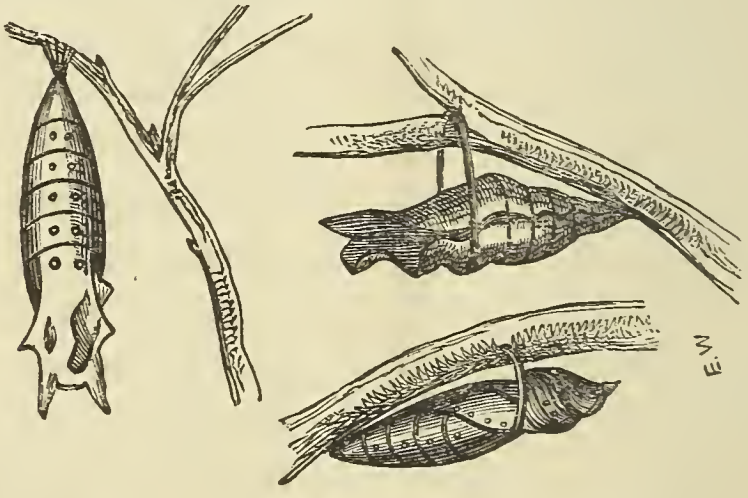
You may see this manœuvre any day, by giving a tree a hearty shake. Down will drop myriads of caterpillars, and hang in the air, each one suspended by its silken cord. As soon as the tree is quiet, and the danger seems to be over, they will all climb up their ladders, and begin feeding as if nothing had happened.

And the caterpillar can cheat its great enemy, the bird, by behaving in much the same manner. When the little leaf-roller is in its green gallery, a bird will often put in his beak at one end of the roll, and then out the caterpillar will dart at the other; and drop down its thread until it is out of sight. It will fall as low as six feet, falling a foot at a time, and then pausing, as if to take breath, and when the bird has flown away, disappointed of his prey, the cater-

pillar will leisurely climb up its thread, and get safe back into its nest.

But the house the caterpillar makes, and all the various ways it has of defending itself, only avail so long as it is a caterpillar. It must, by and bye, become a chrysalis, and exchange a life of activity for one of death-like torpor. Quite helpless, and without any means of defence, or even of motion, it must remain at the mercy of its enemies, and exposed to all the changes of wind and weather.

Then it is, that the spinnaret is all-important: for it enables the caterpillar either to spin a girdle to support its body in some sheltered spot, or else to weave a cocoon, that will hide it, like a shroud, during its long sleep.



The caterpillar of the butterfly does not make a cocoon, as that of the moth does; for it lies

a much shorter time in the chrysalis state. It simply suspends itself by the tail; or by a girth passed round the middle of its body, and secured to the gate, or branch, it has chosen for its retreat.

When the caterpillar is about to become a chrysalis, it leaves off eating, and wanders, hither and thither, as if it were bewildered. But it is in fact searching for a safe place, where it may suspend itself out of sight, and, if possible, out of reach of danger. We will suppose it to have fixed upon the under side of a branch; and the first thing it does is to spin to it a little button of silk, strong enough to bear its own weight. Then it thrusts its hind legs into the button, and with the hooks upon the feet takes firm hold upon the threads. When it has made quite sure the button will not give way, it suffers itself to fall, and hangs with its head downwards.

It next bends itself backwards and forwards, in every direction, until the skin splits at the back of the head, and out comes a part of the chrysalis. The chrysalis wriggles itself well about, and makes the slit longer and longer, until it reaches from the head to the tail.

So far, so well. But the chrysalis has to free itself from the skin of the caterpillar, and to hang itself up in its place; and as it has no feet,

or apparently anything to hold by, this is no trifling task. It sets about it by rolling the skin round and round like a stocking, beginning at the head, and pushing it all up to the tail. It is now hanging by the old skin, and the silken button is some distance above it. It must climb up until it reaches it, and how do you think this feat is accomplished?

The rings or divisions of its body are so supple that they serve it instead of hands; and with two of these, as with a pair of pincers, it nips up a piece of the skin, and then bends its body so as to draw out its tail. It is now free of the skin, and only holds to it by its rings. You might be almost afraid it would fall, but there is really no fear of any such accident. The silk button is still above it, so it nips up a piece more of the skin, higher up, and then another, a little higher still; thus it makes the old skin serve it as a ladder, until at last it reaches the top, and feels about with its tail for the silk button. The tail is furnished with a number of little hooks, that catch upon the threads, and hold it quite firm, and enable it to swing in safety.

Only one more feat remains to be done. The chrysalis seems to dislike very much having the old skin so near it; and makes great efforts to throw it down. It seizes the threads, to which

the skin is hanging, and whirls itself round and round, until it has broken them, and the skin drops. If it cannot do this the first time, it tries again and again, often as many as four or five times, and is almost sure to succeed at last.

There are some chrysalides of butterflies that, instead of hanging by the tail, suspend themselves by a thread round the middle of the body. The caterpillar begins by making the silken button as the other did, and hooking its hinder feet into it. It then spins the girth, carrying the thread over its body, and fastening it on each side, to the branch. It carries the silk backwards and forwards fifty or sixty times, although the girth is so fine that it looks like a single thread. Some caterpillars, however, spin the girth like a loop, and then creep into it. The life of the chrysalis depends on the loop being strong enough, for if it were to break, the consequence would be fatal. The chrysalis would fall to the ground, and inevitably perish.

An experiment was once tried upon a number of caterpillars that were about to go into their chrysalis state.

They were put into a box, where some of them were allowed to finish their silk buttons in peace, and swing themselves in the natural manner. Others, however, were taken off when they had

only half finished spinning it, and made to begin over again, in a different place.

They were again taken off, in the middle of the process; and began a third time to spin the button. Again they were interrupted; and this time their patience seemed to be exhausted. They lay down, as if in despair, at the bottom of the box, and went through their change without hanging themselves up at all.

You may easily amuse yourself by watching these two ways that caterpillars have of suspending themselves. They are too cunning to let you see them out of doors; but if you put a number into a box and fed them every day, you would be almost certain to surprise them in the act. The hairy caterpillar, you had taken from the nettle, would hang itself up by its tail; and the green and yellow one, you had found on the cabbage, would suspend itself by a girth.

This green and yellow caterpillar, that comes in time into the white cabbage butterfly, often fixes its girth under the coping of a wall, or some such projection. But as if it knew that the threads would not hold fast to brick or stone, it spins a web over the space, where its girth is to hang; making, in fact, a good foundation of silk.

A naturalist put one of these caterpillars into a box, and covered it with a piece of muslin

instead of a lid, to see if it would do the same as if it had been upon the wall. But no such thing. The caterpillar seemed to know that muslin was a very different material to brick or stone, and that there was no need to spin a web upon it. So it hooked its hinder feet into the threads of the muslin, and spun its girth without any other foundation.

I must say a word or two about the colour of the chrysalides, which is often very beautiful. Some of them shine as if they were gilded with burnished gold, and people once fancied they really were gold. But science soon made it clear that this was not the case. The outer skin of the chrysalis is of a transparent yellow, and gives a golden tinge to the inner membrane, that is of a shining white. This golden hue only lasts while the inner membrane is moist. It becomes dry before the butterfly appears, and then all trace of gold vanishes.

The chrysalis is sometimes called Aurelia, but both words mean the same thing,—gold.

The time the chrysalis has to remain before it is a butterfly, depends very much on the warmth of the atmosphere. Réaumur, the naturalist, found this out, and made some rather amusing experiments. What do you think of hatching butterflies under a hen? The idea is strange,

and almost laughable, but it was really done, and succeeded admirably. He fastened the chrysalides, on pieces of paper, and enclosed them in a hollow ball of glass, about the size of an egg. He then put them under a hen, and the next day went to see how they were going on. The glass on the inside of the ball was covered with minute drops of moisture, and he unstopped it, and allowed them to dry up. He left it again under the hen, and at the end of four days, to his great joy, he found a butterfly. Very soon all the chrysalides were hatched, and this at least a fortnight before their proper time. They seemed, however, none the worse for it, and no one could have guessed they had been brought into the world in this unnatural manner.

Réaumur next tried the experiment of keeping the butterflies unhatched by exposing them to cold. He put the chrysalides into an ice-house, and the butterflies did not appear until six weeks after the right time.

Naturalists were very glad to have made this discovery of hatching the chrysalis, for they thought they now possessed the power of bringing insects into life, or of keeping them back at pleasure. And so they could in some instances; but in others, Nature baffled all their calculations.

A number of the chrysalides of moths, enclosed in their cocoons, were put in a heated chamber to be hatched quickly, and others, of exactly the same species, were put into the cold in order to be kept back. But this experiment failed, and the moths made their appearance all at once, not one being earlier or later than the rest.

A foreign chrysalis suspended by the tail, and also by a band inserted on each side.

CHAPTER THE EIGHTH.

COCOONS, BUT NOT OF SILK.

The caterpillar of the moth, as I told you before, lies in the chrysalis state a much longer time than that of the butterfly does. Indeed, it often passes many months in this defenceless condition; and something more is required than a mere girth, or hanging itself up by the tail. Nature has therefore given it the instinct to form a cocoon, or case, within which it may lie completely hidden.

The caterpillar seems to know how important it is to make this provision for itself, and when the time has come, it sets to work with the greatest industry, and as if it had not a moment to lose. Directed by an Almighty Hand, it plans out its temporary dwelling with the skill of an architect. It contrives means for the comfort and security of the future chrysalis; and ensures the outlet of the moth, with an ingenuity that

cannot help exciting our warmest admiration. Nothing is overlooked or forgotten; and the caterpillar, so humble and despised, seems gifted with a foresight almost miraculous.

Some caterpillars have but a scanty supply of gum, and are obliged to call in the aid of other materials than that of silk, to make their cocoons.

Two of these materials are found within, or upon their own bodies.

When the caterpillar has inclosed itself in a slight framework of threads, it ejects three or four round balls of a paste-like substance, which it pats down with its head, all over the inside of the framework, just as a mason might cement a wall. The paste soon gets dry, and becomes a white powder, that fills up every gap, and makes the cocoon so thick you cannot see through it.

The other material is the caterpillar's own hair; for some, you know, are well provided with this kind of clothing. But as the moth did not scruple to pluck off the down from her body to make a nest for her eggs, so the caterpillar willingly robs itself of its hair, for the sake of the future chrysalis.

It cuts and tears it off with its jaws, and scatters it on every side, and pushes it among the threads of silk, so as to make the cocoon very thick and strong.

This process of pulling off the hair seems to be a painful one; but the caterpillar goes on working with the greatest energy, until its body is entirely stripped of its covering, and the cocoon looks as if it were made of hair. Last of all, it spins a lining of very fine silk, to protect the chrysalis from the prickly points that will surround it.

In some instances the hair is found mingled with the paste, and so both materials are used in the same cocoon.

There is a little hairy caterpillar that has a very droll way of proceeding. It cuts off its hairs, and sets them upright in a ring, side by side, like the sticks in a paling. Then it joins them together with a slight web of silk, and bends them down over its head into a roof, beneath which, it may lie sheltered, and undergo its change.

Another material used in the place of silk, is the bark or wood of a tree. This makes the cocoon very hard indeed, so that it can scarcely be broken, even by the point of a knife. The caterpillar with its strong jaws gnaws off little pieces of wood, and masticates them into a paste; and of this it builds its cocoon, and lines it, as the others do, with silk. There is more strength than beauty in its wooden dwelling, that looks very

rough when it is finished. But one small caterpillar contrives to make an elegant cocoon, not of the bark, but of the outer skin of the twig. It peels it off very fine indeed, and cuts it into narrow strips, so narrow that they look like feathers. These it laces together with such exquisite nicety, that you cannot see the joins.

It is wonderful how this little creature, without any tools but its feet and its mouth, contrives to work so well. But Nature has given it the patience and skill to execute the delicate task; and when it is finished, the caterpillar lines it with silk, and changes into a chrysalis within it. When the moth comes out, she is so like the colour of the twig, that you can hardly distinguish her.

But very often the caterpillar will burrow into the earth, and form its cocoon below the surface.

There are some sand hills, on the coast of Devonshire, into which numbers of caterpillars* dig for security. They feed upon the sea spurge, and will hardly touch any other kind of plant. When the autumn comes, they descend in a body, and hide themselves in the sand, forming loose cases of earth for cocoons. Here they lie till the following summer, and sometimes even till the summer after that; when they come out moths, with green and rose-coloured wings.

* Of Sphinx Euphorbiæ.

The caterpillars are rarely found except on these sand hills; and they are very conspicuous, being of a black colour, with red lines, and white and yellow spots. They are easily found by the birds of the sea-shore, and afford them a supply of food.

The earth-digging caterpillars are all of the same family, but they belong to different species; and each species buries its cocoon a little deeper than the other. As for instance, one caterpillar will spin a web upon the surface of the ground, and weave in leaves and bits of stick, to hide it. Another will go a step farther, and though it keeps still on the surface, will build its cocoon of earth, and make it look on the outside like a little mound. A third will press down the mould till it has made a hollow place, like a grave, where it will cover itself up, and lie just below the ground. A fourth will dig a little deeper, and another deeper still, and so on, until at last, one caterpillar will bury itself at least a foot below the ground, before it begins to make its cell.

If you were to dig up one of these earthen cocoons, you would take it at first to be nothing but a clod of mould. But if you broke it open, you would see that its outer wall was made of pellets of earth, fastened together with gum; and

that within, it was lined with a tapestry of silk, so fine, that the naked eye could hardly see it.

On this soft and luxurious couch, the chrysalis lies protected, during its long sleep, from the cold and wet.

When the caterpillar finds the earth too hard and dry for it to knead into pellets, it ejects a fluid from its mouth, that moistens it, and makes it more easy to work. And another thing I must tell you. The caterpillar has no means of throwing aside the earth, as people do when they dig a hole, and you might wonder how it manages. The cunning little creature turns itself round and round, and so presses the earth down on every side, until it has made a hollow large enough for its purpose.

In process of time, the caterpillar that has buried itself a foot beneath the surface of the ground, comes out a very large moth,* with a rather grim appearance; for it has a mark upon its back, that is a little like the head of a skeleton. It is called the death's head moth, and in days of ignorance, people were foolish enough to

* Sphinx Atropos.

be frightened at it, and to think that if they saw it, they should be certain to be taken ill and die. In the Isle of France, this superstition is very common indeed; and the natives believe that the dust from its wings will cause blindness, if it falls into their eyes. So, in the evening, when the moth comes out, if it should chance to flutter

Death's head moth.

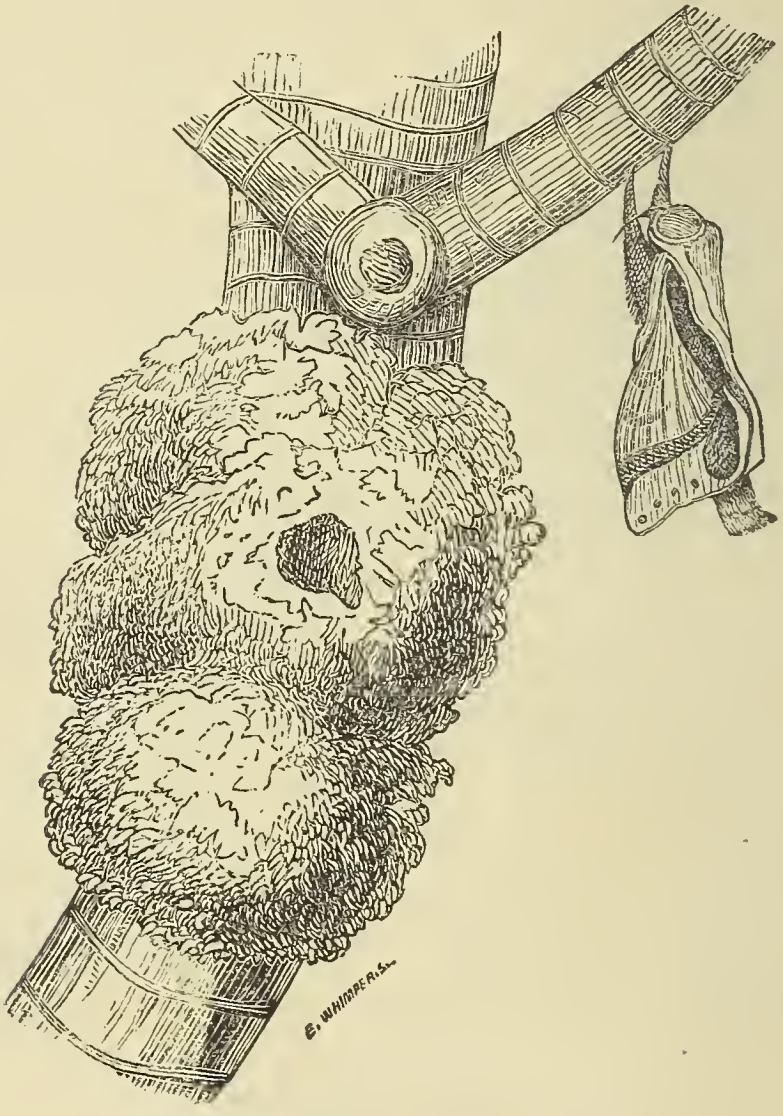
into the room, and extinguish the light, as it often does, every body runs away in alarm, and prophesies all manner of disasters.

Besides its great size, and the mark upon its back, the death's head moth can make a plaintive cry, that is also regarded as an evil omen. But in spite of the fear it causes, it is a most harmless and inoffensive creature, and quite unable, either by its cry or its skeleton head, to defend itself from danger. It is very fond of honey, and will often venture into a beehive to steal a little. But the valiant bees, regardless of its size, or of its bad name, rush upon it, and sting it so severely that it generally dies.

The foreign caterpillars are much larger and more striking than those in our own country; but it is very difficult to find their cocoons. Many of them live in the inside of trees, in the pulp of fruit, or in the pith of plants, and keep their cocoons completely hidden. There is one* whose habits are a little like the caterpillar of the goat moth, that you may remember makes its cell in the very centre of the tree. It, too, forms a chamber in the heart of the oak, that grows in New South Wales, and feeds upon the bark, and sappy wood about the entrance. But as it does

* Hepialus lignivora.

not wish to have the mischief it is doing found out, it weaves a thick mass all round the stem, of silk and fragments of bark together, thus fortifying its dwelling, and at the same time concealing it. Beneath this mass, which looks like an excrescence, the caterpillar makes a winding passage, where it lies hidden while it gnaws. But



Hepialus lignivora moth, and nest.

when it is about to become a chrysalis, it retires to its inner chamber, and weaves a thick curtain across the opening, to shut itself completely in. Long before it changes to a moth, the mass round the outside of the stem, that it has taken so much trouble to form, falls away. And this is all the better, as the disguise is not wanted any more, and it might prove a barrier to the outlet of the moth.

Do you remember the curious stinging caterpillar, with four knobs on the front, and four on the hinder part of its body? It, too, lives in New

Cocoon like a fruit

South Wales, and feeds upon the bark of a tree. It spins a cocoon in the shape of an egg, and varnishes the threads over with gum, that when it gets dry, hardens into a solid crust. The cocoon looks just like a fruit hanging from the tree, and has no doubt often been mistaken for one.

CHAPTER THE NINTH.

COCOONS OF PURE SILK.

The faculty of spinning silk is brought to perfection by a species of caterpillar, with a smooth skin, and a green or yellow body, called the silkworm. It has so plentiful a supply of gum, that it needs no other material for its cocoon, but makes it entirely of silk. Indeed, out of its superabundant store, it weaves two cocoons, one within the other. The inner one is the finest and most valuable, and is reeled off without any trouble; but the outer one is of coarse rough threads, and is so ravelled that it cannot be wound, and is known by the name of flos-silk.

The silkworm intends the outer covering as a protection from the rain, for in a natural state, it would hang its cocoon under a tree; and though it is housed and sheltered, it never departs from what it has been taught by instinct.

When the flos-silk, and the fine silk, have both been taken away, there still remains a ball of thin transparent skin, which is the lining of the cocoon. These delicate balls are not thrown away as useless; they are sometimes carded into silken flax, or else painted up and made into artificial flowers.

Silkworms are the only insects, except bees, that man has thought it worth his while to rear, for the sake of the riches they produce. Year by year, they work for us with unceasing industry; and without them we should lose the most costly and beautiful article of our attire. They are the

> "Millions of spinning worms,
> That in their green shops weave the smooth-hair'd silk."

But there is no need to say much of the silk-worm, as the subject is too familiar, and has already been noticed in speaking of the mulberry-tree, in a previous volume of "The Observing Eye."

I might however tell you what I think will amuse you. The Chinese are so economical, and so determined to waste nothing, that when they have wound off the silk from the cocoon, they serve up the chrysalis as a dainty dish, and actually eat it!

And a curious circumstance has recently happened that I must not omit to mention.

A number of silkworms have been found under a hedge in Kent, very contentedly feeding upon bramble leaves. They were in different stages of their existence. Some were eating with their usual voracity. Some were beginning to spin; some were roving restlessly about in search of a suitable place; while others had already enclosed themselves in their silken cocoons, and were hanging suspended from the weeds, but more particularly from the bramble bush.

How they came there it is impossible to say; but they have been pronounced to be exactly the same species as that cultivated abroad with so much care.* And if silkworms can thrive upon the leaf of the bramble, and other indigenous plants, it is thought not impracticable to rear them in this country with but little labour or expense.

It would be a very good thing for us; and all the more desirable, because a disease, something like the plague, has lately broken out among the silkworms in France, and carried thousands of them off. The disease was supposed to arise from the worms being too much crowded together, and the only cure seemed to be to sprinkle the

* Bombyx mori, the common silkworm.

mulberry leaves with sugar. The silkworms that fed upon the sugared leaves recovered; or if they were not ill, escaped the disease altogether.

The silkworm, reared in Europe, is only one of a numerous family, that spin silken cocoons in different parts of the world, and of these you may like to know something.

In Bengal, at a certain season of the year, the natives of the hill country go wandering into the tangled mazes of the jungle. They are looking for silkworms, that feed upon the leaf of a tree, called the byer-tree; and as soon as they espy any traces of them, they cut off the branch with the young brood upon it. When they have collected a great many of these branches, they carry them home, and place them among the foliage of the asseen trees, which the silkworms like quite as well as the byer-trees. And so precious are the tiny worms, for the sake of what they will spin, that the natives never lose sight of them, but watch night and day, lest the bats or the birds should devour them.

In a month's time the worms attain their full size, and are so heavy that they cannot crawl the right way, or with their backs upwards, but hang by their feet to the underside of the twig.

When they are preparing to spin, they fasten two orthree leaves of the tree together so as to

form an outside covering, and then begin to weave the cocoon within it. They suspend it,

Caterpillar at its full size.

from the branch, by a strong thick cord of silk; and when it is finished, it is about the shape, and nearly the size of an egg.

Here the chrysalis lies dormant from the autumn till the following midsummer, when

Cocoon suspended.

the moth* comes out, and flies away to her native jungle. She will lay her eggs again upon

* Saturnia mylitta.

the byer-tree, which is, at that time, in full perfection, and the natives must take a journey as they did before, if they wish to have any of the young worms.

You would think they might spare themselves this trouble every year by keeping the moth to lay her eggs at home. But they say it is quite impossible to prevent her escape. She comes out of the cocoon in the middle of the night, and even if it is locked up in a box, her dexterity and determination are so wonderful, that she always succeeds in getting away.

The cocoon is placed in a ley, made of plaintain ashes and water; and as soon as it is soft enough, the silk is reeled off. It is called by the natives the Tusseh silk, and is coarse and dark, but very strong; and is woven into a cloth that has been worn by the Brahmins from time immemorial.

There is another silkworm also found in Bengal, called the Jarroo, because the cocoon is produced in January, the coldest month in the year. This, too, feeds on the leaf of the asseen-tree; and is very much like the one I have been describing, only that the female moth can be prevented from flying away. Her partner, however, has never yet been kept

in confinement, but always comes from the jungle.

The natives, who watch these worms as they do the others, give the most astonishing account of the long flights this insect will take. They often catch him, and mark his wings that they may know him again, and by doing so have found out that he has flown a distance of more than a hundred miles!

The silk from the Jarroo cocoon is reeled off, and makes a cloth that is very durable, and well adapted for wear in a hot climate.

But the silk spun by the Arrindy worm, as the natives call it, is by far the most durable of any. Indeed, it seems as if the cloth made of it would never wear out; and a garment often descends from father to son, or from mother to daughter, as good and strong as ever. It must, however, be washed in cold water, or else it will tear like old rag, and never be good for anything again.

The Arrindy worm is reared by the natives in the same way as the silkworm is with us. It is of a pale sea-green color, and exceedingly voracious; devouring every day a great deal more than its own weight. The chrysalis only lies about twenty days; and when the moth comes

out, she seems very well contented with her prison, and makes no effort to escape.

The silk is so delicate that it cannot be wound or reeled from the cocoon, and this makes it more difficult to manage, and not so valuable. The natives contrive to pull off the threads from four or five cocoons, and twist them together; the twisted silk is then woven into small pieces of cloth, which are very coarse, and have to be well beaten in order to be made pliable.

An Englishman once brought home some Arrindy worms, and when they had finished their cocoons, he was quite determined to have the silk reeled off in the usual manner. He had brought a native servant, from the very spot where the worms were procured, who laughed heartily at the idea of winding the Arrindy thread. But his master persisted in having his own way, and tried again, and again, to have the silk wound. But at last he was obliged to give in, and have it spun like cotton.

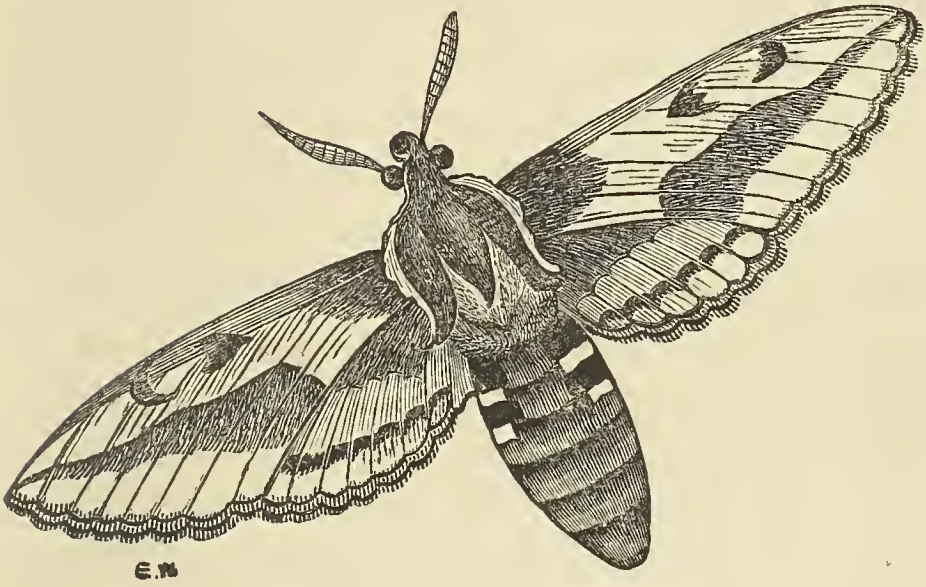
I will only mention one more of these wild silkworms.

From the branches of the sassafras, and the spice-tree, in North America, there will often hang what look like withered leaves, and you would think the next gust of wind might carry them away. But they are in reality the

cocoons of silkworms, who have contrived this covering, it may be to escape notice. When the worm began its preparation, the leaf was quite green and perfect; and she first of all covered it with a coating of silk, that extended up the foot-stalk, and was firmly wrapped round the branch, so that the leaf could not fall or be wafted away. The silkworm next drew the edges of the leaf together, so as to make a case in which to spin the cocoon. For a time, the leaf, that wrapped round the cocoon, remained green; but by and bye, it became brittle, and changed its color to a red or brown, and in the end, was carried away by the wind and storm of winter. Nothing now remained but the cocoon itself, which hung securely by the silk that covered the foot-stalk, and was wrapped so firmly round the branch.

A great many silken cocoons would be very valuable, if the silk could only be wound off them. But the gum, this kind of silkworm uses, is so hard that nothing can dissolve it; the silk, therefore, can only be used by tearing it to pieces, and carding it like wool. You can well imagine, how such a process must waste and spoil it; and what a benefit it would be if something could be discovered that would soften the gum without destroying the thread. The moth herself is

possessed of such a fluid, and uses it in making her way out. But of this, and of the way in which moths in general contrive to get out of their cocoons, you shall hear in the next chapter.



CHAPTER THE TENTH.

THE ESCAPE OF THE MOTH.

The cocoon of the moth is, in fact, a shroud wrapping closely round the buried chrysalis. In many instances it is very hard and strong, and without any visible opening; and is sometimes placed in the heart of a tree, as in the case of the goat moth; or rolled up in the folds of a leaf, as in that of the little leaf roller; or buried in the earth, as we have seen when speaking of the earth-digging caterpillars.

The chrysalis can have no light, or air, or space, beyond what the walls of its prison afford it. It lies in a temporary grave; and you might wonder how the moth, with her delicate wings, and having neither the strong jaws nor powerful muscles of the caterpillar, can ever force her way out. Hers is indeed a wonderful resurrection; and but for the care and ingenuity of the caterpillar, could never be brought to pass. But this little creature, as if it could foresee from one end of its existence to the other, contrives to meet every difficulty.

We will begin with the silken cocoon, in the meshes of which the moth might struggle a long time, and yet not be able to free herself. And how she did free herself was once a mystery: and it was thought she must use her large prominent eyes as a file, to cut through the silken threads.

It is not very clearly determined now how she manages to make her exit; but one thing is certain, that to help her, the moth is provided with an acid, as you heard in the last chapter, that she can eject from her mouth, and so dissolve the gum or any hard material of which the cocoon is made. This is how the puss moth forces her way through the cocoon made of bark, and that is so hard, a knife will scarcely cut it.

But besides the acid, there is another aid given to the moth. When the chrysalis case bursts, there is a small quantity of the fluid that once filled it, still remaining; and this flowing into the cocoon, helps to soften and dissolve it. One end of the cocoon is observed to be wet, for an hour or two, before the moth appears; and in the process of making her way through, she so breaks and spoils the silk, that when it is intended to wind it, she is never allowed to come out at all; but is killed within her cocoon by having it plunged into hot water.

The leaf-rolling caterpillar weaves its cocoon within the green gallery where it has been feeding, and slings it up like a hammock. It is of very slight texture, and forms no barrier to the outlet of the moth. But she is too small and feeble to force her way through the roll of leaf, and would remain a prisoner for ever, unless the caterpillar had provided against such a misfortune. But the caterpillar, before it became a chrysalis, took care to gnaw a little piece of the leaf away, in a circle, and to leave only the outer skin unbroken. This is to serve as a door for the moth; but she might not be able to find it, and so waste a few moments of her short life in looking for it. As if the caterpillar had foreseen the dilemma, it spins a thread from the door, and secures it to its own head. When the moth comes out of the chrysalis, the thread is still fastened to her head, and, like a clue, guides her to the door, which she can easily push open, and gain her liberty.

The caterpillar that cheats the farmer by eating his corn, does much the same thing. It makes a cocoon within the hollow skin of the grain, where it changes into a chrysalis. But the hole by which it entered is so very small, that the moth could not possibly get through it. So the caterpillar gnaws a little circle in the grain, leaving as

the other did, the outer layer of skin unbroken; and this answers the purpose of a door, and is pushed open by the moth.

But how do you think the moth of the great caterpillar, that makes its cocoon in the very heart of the tree, gets out? The trunk is very thick, and there is often a long passage, from the chamber where the chrysalis lies, to the open air. The moth is a large one, and there would be no room for her wings to expand, either in the chamber or the passage. Some other contrivance is needed than the door, or the clue of thread, and accordingly we find one quite as ingenious.

The chrysalis is furnished with sharp points upon its head, and it keeps pushing these against the cocoon until it has broken it. Then it wriggles itself out of the hole, and works its way gradually along the passage, helped on by the sharp points that it uses like arms. It reaches the bark just in time for the moth to come out. She finds herself close to the outlet, and has nothing to do but to spread her wings and fly.

But the moth that is buried in the earth seems even worse off than that in the tree. She is a foot below the surface, and there is no passage along which she can make her way. She is shut up in darkness, and as it seems in a living tomb. But

Infinite Wisdom has also provided her with the means of extricating herself.

The chrysalis is furnished with a number of little points down its sides, and under its body, and when the time is come, it is impelled by instinct to work its way upwards, and upwards, through the soil, until at length it has reached the surface, and its head and shoulders are pushed above the ground. The little points have helped it along like arms, as those of the goat moth did; and then the chrysalis case bursts, and the moth finds herself, not in a prison underground but in the enjoyment of light and air.

Many of the cocoons that are found above ground, have a lid large enough to allow the moth to pass. You would not see the lid unless you examined the cocoon very carefully, for it looks as if it were one solid piece; but there it is, fastened down by a few slight threads, that the moth can easily break.

But sometimes the cocoon itself opens, to allow the moth to pass, and then closes again behind her.

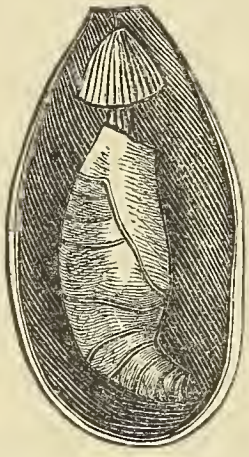
There is a curious cocoon spun by a small caterpillar that feeds on the black alder tree. It is of two pieces, shaped like a boat upside down, and is elegantly fluted with cords of silk, and the spaces between are filled up with fine network.

The caterpillar does not spin it round and round its body as is generally done, but half finishes it before getting in. The two pieces are glued together quite fast except at one end, and here, though it seems as strong as the rest, they are merely made to meet, and held in their place by a few threads, that are fastened down on the inside. The threads are so slight that the moth can break them, and push her way out, between the two pieces. But they instantly close behind her, and the boat looks just as it did before.

But the most curious kind of cocoon that opens and shuts in this manner, is that made by the caterpillar of the emperor moth. It is very common; and you may find it, at the right season, on the willow or the pear tree. It is made of rough-looking silk, and is shaped like a flask, with a hole at the narrow end. But to prevent any insect getting in, the caterpillar gums together a number of threads of silk, and sets them like sharp spikes round the inside of the hole. The spikes are as elastic as whalebone, and can easily be pushed open from within; but if an insect were to try to force an entrance, it would be received on the sharp points like so many wires. In fact, the caterpillar has made the cocoon after the fashion of a trap; only in this case the moth within the trap can get out, and nothing

from without can get in; while in the real trap, the poor little mouse can get in quickly enough, but can never get out again.

The caterpillar is not satisfied even when it has set its sharp spikes round the doorway. It spins a little dome below the opening, and when it becomes a chrysalis, it hangs suspended beneath it.



Chrysalis of Emperor moth.

In due time the moth makes her appearance, and escapes through the trap-door, the wires closing after her, so that no one can tell she is gone.

There is a story told of a person who kept a cocoon of the emperor moth in a box, and one morning, was very much puzzled to find the moth fluttering about beside it. He thought she must have got out by magic, for the cocoon looked exactly as it did before; and it was not until he cut it open and discovered the trap, that the mystery was solved.

The time that a chrysalis lies in its cocoon is very variable, and depends on the size of the moth, and the season of the year. As, for instance, if the cocoon is spun in the autumn, the chrysalis will remain stationary all the winter;

but if it is spun in June, the moth has plenty of summer weather before her, and will make her appearance at the end of three or four weeks.

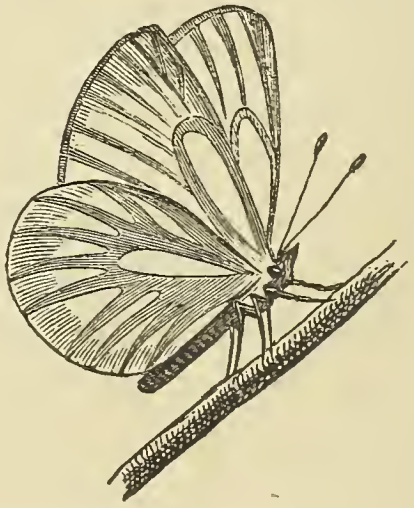
But it is very extraordinary, that some moths have a fixed and certain hour of the day or night for coming out of their cocoons, when they will burst forth let the weather be what it may. Thus the wild silkworm that spins the Tusseh silk, always escapes in the middle of the night; while the moth of the common silkworm comes out at sunrise. The hawk moth, the caterpillar of which feeds on the evening primrose, appears also at sunrise; and the hawk moth of the lime tree appears with equal certainty at noon. Then the great death's head moth need never be expected before four in the afternoon, or after seven in the evening; thus following some law unknown to us, but fixed and unchangeable.

And a law just as mysterious prevails with regard to the moths that come out of their cocoons in the cold and stormy month of February.

A gentleman once caught one of these moths, and kept her in confinement. She laid her eggs; the caterpillars were hatched, ate voraciously, changed their skins, and went through all the circumstances of their caterpillar life. They then spun cocoons, and changed into the chrysalis state. There were as many as thirty-six of these cocoons, but when February came, only twelve of them

produced moths. This was very odd, and the gentleman, after waiting a long time for the rest to appear, concluded the chrysalides were dead, and thought no more about them. But to his astonishment, the next February twelve more moths came out, none the worse for the unreasonable time they had lain in their cocoons. The next February the remaining twelve burst into life, and thus it had taken three successive seasons to hatch the whole brood.

We can only imagine one reason for the delay. When the moths come out, the winter is not nearly over: there may be rough weather, and frost and snow, and it might chance, if the whole brood were hatched at once, they would on some occasion or other, be all destroyed. So part are kept back until the following year; and by this simple arrangement the species can never, by any accident of weather, become extinct.



CHAPTER THE ELEVENTH.

THE TRANSFORMATION.

We left the chrysalis of the butterfly suspended by the tail, or else by a silken girth or loop, that it had spun round the middle of its body, to keep itself from falling.

It is, indeed, in a death-like torpor. It hangs quite motionless, and gives no sign of life, except it is touched, and then only by a slight jerking. Nothing can be less like a butterfly than it is at present. It has neither external wings, nor legs; and the membrane or skin that covers it, is not like that of the caterpillar, or of the butterfly, and is filled with a substance so soft and pulpy, as to be almost like a fluid. The thing it most resembles is an Egyptian mummy swaddled up in bandages; and how is it possible for this weak and inanimate creature to burst its covering, and issue forth adorned with all the colors of the rainbow?

Let us watch the progress of its transformation. Look at it after an interval of time, and see how

changed it is! Its color was of a golden hue; but that has vanished, for the fluid has dried up, and you can trace distinctly the form of the insect within. The wings are neatly folded up, and packed upon the shoulders; they are at present of a dull muddy color, and give no symptom of the brilliant tints that will, by and bye, adorn them. The antennæ and the legs lie straight down upon the breast, and already they are so firm and strong, that the insect can move them about.

It is very near the period of its escape, and while we are looking at it, it becomes violently agitated, and struggles with its legs, until the case, that holds it, bursts. But each part of its body, its legs, its antennæ, and its trunk, is enclosed in a separate case, and it has to draw them out, just as we draw our fingers from a glove.

It is now partly at liberty; its legs are free, and it works them about, and labours to get clear of its prison. The skin of the back flies open, and uncovers the wings. The chrysalis case is in ruins; and the butterfly pauses, her feet resting upon it, and as if she were exhausted with her efforts. Her crumpled wings droop like wet paper; they are no larger than your finger nail, and still present no appearance

of color or beauty. How are they to expand and become vigorous and ready for flight? I will tell you.

The wing of the butterfly is composed of two membranes, that at first do not touch each other, but leave a space between. This hollow space has a number of tubes or vessels, called nervures running through it, and when the nervures are empty, as they are at present, the wings droop, and have neither power nor beauty.

But presently, a fluid, that answers to the blood in animals, begins to rush through them; the air also gains admittance and fills the air-vessels; and a wonderful change takes place. The wings that were folded and doubled up, gradually open and expand, for the fluid is forcing its way into every nervure, and the nervures themselves are increasing in size as the wing is.

Everything depends on the proper circulation of the fluid; and there is one conjecture about it that I ought not to pass over, though it does not relate to the butterfly.

When the emperor moth comes out of her cocoon, it has been supposed, that the trap of spikes, set round the doorway, press upon her body, and assist in forcing the fluid into her wings. This seems very likely to be the case, for a chrysalis was once taken out of the cocoon, and the moth hatched, without being

allowed to pass through the trap. But her wings were quite useless, and she was too feeble ever to fly.

All this time, the sun is drying the moisture from the butterfly's wing, and the two membranes that were before apart, are drawn together, and become one. The butterfly helps on the work of circulating the fluid, by constantly fluttering. At first, while the nervures were empty, she could not move her wings; but now the nervures are getting full, and she can raise them with some degree of vigour. The colours begin to shew themselves; bars and spots of gold and purple flash into sight, and become deeper and brighter every minute.

At length, the wings expand in all their beauty; and the butterfly rises triumphantly above the case that has been her prison.

The wonderful transformation has taken place. She has attained her last and perfect state of existence, and will neither grow nor change any more. She has passed safely through her caterpillar, and her chrysalis, life; and will no longer grovel on the earth, but rise into the air a creature of enjoyment, and one of the most beautiful of Nature's productions.

The resurrection of the butterfly is so familiar and so well understood, that it excites no surprise. But if we heard of it for the first time, we should

think it miraculous, and scarcely believe that this elegant insect lay hidden, not only in the chrysalis, but in the body of the caterpillar.

Indeed, it must ever remain one of the marvels of creation.

Many years ago, before the study of natural history was as much thought about as it is now, a Grand Duke of Tuscany paid a visit to Holland. He went to see everything thing that was worth looking at; and all manner of attentions were paid him by the rich and noble of the land.

But, one day, the famous naturalist, Swammerdam, called upon him, and brought something in his hand, that he said was a great curiosity, and better worth looking at than anything the Grand Duke had yet seen. And what do you think it was? It was only a caterpillar, just about to change into a chrysalis!

He plunged it in spirits of wine for a few minutes, and then called the Duke to notice, how in the body of one creature, another, and quite unlike it, was hidden.

Here was the butterfly, in her first and humblest state of being, veiled in the lowly form of the caterpillar. Every part could be distinctly traced. The wings were rolled up tight, and packed between the first and second rings of the body; the antennæ and the trunk were coiled up in front of the head, and the legs, though rather

different in form, were sheathed in those of the caterpillar. "Here!" cried the naturalist, "is a greater wonder than any you have yet beheld!"

And the Grand Duke, struck with admiration, confessed that he had never looked on such a marvel before.

You can well imagine that the butterfly, in this three-fold life of hers, has been regarded as the most striking emblem of the human soul. And such an idea must suggest itself even to a child. In the first stage of her life, the butterfly is a grovelling worm, never rising above the earth, and wholly occupied in providing for her necessities.

When this is over, she is shrouded in the chrysalis, and for a season, lies without apparent life or motion. But she is only waiting for her last change to come, when she will emerge from her prison, a perfect insect, and with no resemblance to what she was before.

Thus man, also, has a three-fold life.

At first he is a creature of earth, absorbed with bodily wants, and spending most of his time in supplying them.

Then he passes into another, and a second state. He lies down, and is shrouded in the grave. "There is no more work, nor knowledge, nor device." His mortal life is ended, and his place will know him no more. But all this is

only the preparation for his great and final change. He will rise from the tomb, not in the weak corruptible body he had before, but in the body that shall be. And of this we know nothing, but what the Bible tells us, that it will be "a new and glorious body," "without spot, or wrinkle, or any such thing."

"Then, this corruptible shall have put on incorruption, and this mortal shall have put on immortality!"

CHAPTER THE TWELFTH.

THE BUTTERFLY.

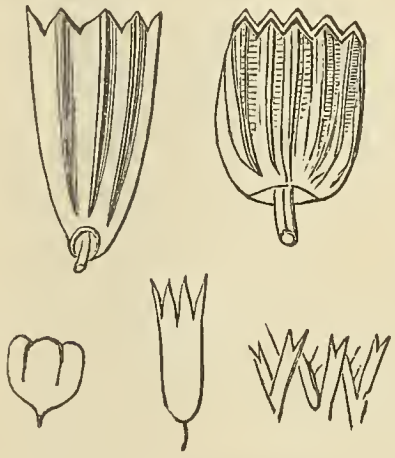
Every one is glad to see the butterfly. She comes when the daisies and the buttercups spread their rich carpet over the meadows; and her appearance never fails to remind us of the sunshine and the flowers of summer.

Nothing can be more refined than the habits of the butterfly. Her only nourishment is honey and nectar; her native element is the air; and her favourite resting-place the bosom of a flower. No other insect can vie with her in point of beauty and splendour of dress; and it would be quite impossible to describe the endless variety of markings, cloudings, and spottings, that embellish her wings.

Her wings are very large in proportion to the size of her body, and it seems as if Nature had wished to have an ample space for the display of her pencil. The under-side is often as gaily painted as the upper, and entirely in a different

manner, so that each wing presents us with two separate pictures.

If you would like to know how the contrast and effect of colors is produced, you must look at one of the wings through a microscope. To the naked eye it seems as if it were covered with dust; but under the glass, you will see that each particle of dust is a minute scale or plume. These plumes are all manner of shapes and colors; and in them reside the lovely tints that so please the eye. They are mounted upon little footstalks like quills, and if you were lightly to rub the dust from the wing, you could trace the minute holes into which they fitted, and that look like lines of innumerable dots. The dots run in a slanting manner from one side of the wing to the other; and those on the under-side sometimes cross those on the upper, and so form a lozenge-shaped pattern.



Scales of wings.

Thousands upon thousands of these tiny plumes clothe the wing of the butterfly; and they are set so close together, that one row rests upon the next, and overlaps it like the

tiles in a roof. Sometimes the plume will be divided at the tip into a number of little teeth, and then again it will be quite plain, without any division at all. The shape also is very various, even on the same wing. As, for instance, on one part the plumes will be oval; on another there will be a cluster of three-cornered plumes, and then a group that are heart-shaped; and here and there taller ones grow up amongst the rest, and overtop them.

The clusters of plumes are quite different from each other in color, and form the pattern of clouds and bars and spots, that give the wing all its beauty. In some cases the plumes so completely stud the wing, that nothing else is to be seen; but in others, they leave spaces, where the transparent membrane shines through, and these spaces look like so many windows.

The butterfly has, as you know, two pairs of wings, and when she is at rest, she holds them upright. The hinder wings of the swallow-tailed butterfly* are each prolonged into a tail, and this gives her a very bird-like appearance. Such an appendage to the wing is rare in England, but in the tropics it is very common indeed. The tail will be of a great length, and there

* Papilio machaon.

will even be three or four tails upon the same wing.

One of the long-tailed butterflies,* of Brazil, is a giant compared to any found in this country, and the wings are of a brilliant blue. They glisten and shine in the sun so much that birds are said to be dazzled by them, and often suffer the butterfly to escape.

The butterfly, with her broad sails of wings, is able to support herself for a long time in the air. She seldom flies in a straight line, but in

* Papilio meneläus.

a zig-zag manner, so that a bird finds it difficult to seize her. She will be either above or below him, or on one side or the other; and though he can fly much quicker than she can, he does not often catch her.

The purple emperor* has the stoutest wings, and flies higher and swifter than any other English butterfly. He can remain several hours in the air, and soars almost like a bird of prey. The title of emperor has been given to him, because of the lustre of his purple plumes, and because he fixes his throne on the summit of the loftiest oak. At mid-day, when the sun is shining, he takes his flight, and mounts higher and higher, until he is lost to view. If he happens to meet another emperor, the monarch of a neighbouring tree, they fight as they fly, still mounting upwards, and the battle goes on all the time they are in the air. But when they are tired of buffeting each other, they return to their thrones, and remain in a state of repose until the following noon.

The purple emperor very rarely condescends to settle on the ground, but when he does, it is a good opportunity to catch him. He is so bold, and so determined not to move, that you may go

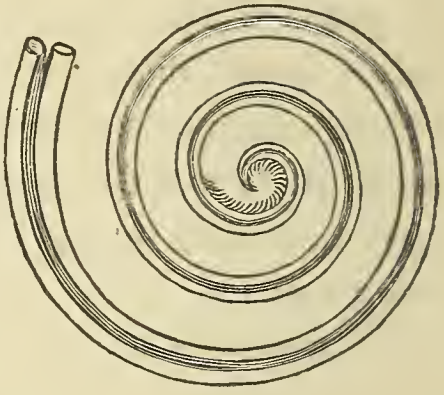
* Papilio iris.

close to him, and even touch his wings, and yet he will not fly.

You remember the description I gave you of the jaws of the caterpillar, and what a great deal of work they had to do. The butterfly does not require any apparatus for eating. All she wants is to sip the juices of the flowers, and a trunk has been given her through which she can suck them up.

The trunk is long and very flexible, for it is composed of a number of rings, after the fashion of an earth-worm's body, which can, you know, twist itself about in every direction. It is formed of three distinct tubes; the two outer ones the butterfly is thought to use for drawing in air, though, like the caterpillar, she breathes through spiracles in the sides of her body, and it is only through the centre tube that honey is sucked up. The most curious part of this trunk is, that the butterfly can pull it in two, through its whole length, and unite it again at pleasure. When the two pieces are apart, you may see they are so grooved down the inner-side, that in fact they make the third tube by merely joining together again. The joining is effected by a beautiful apparatus of hooks or bands, that lace the two parts so closely, that the inner tube is quite air-tight.

When the butterfly does not want her trunk, she rolls it up into a very small compass, like the main-spring of a watch. But in an instant she can unroll it, and dart it into the deepest recesses of a flower, and regale herself upon its sweetest juices.



Nothing can be more exquisite than the workmanship of the butterfly's trunk, or more suited to the life she has to lead. You may watch her plunge it again and again into the same flower, as if determined to search it to the very bottom; then flutter away to another, and hover over it as though to enjoy its fragrance.

The eyes of the butterfly are large, and occupy a great part of the head. If you were to examine one of them under a glass, you would see numberless lines, crossing each other and forming myriads of little squares. Each of these little squares is a lens, which collects the rays of light into a point, and the lines are only made by the lenses fitting into each other. One lens possesses all the properties of a perfect eye; and as the number of them is very great, indeed almost

countless, they enable the butterfly to see on every side of her at once.

The body of the butterfly is composed of rings, but it is so clothed with hair that you do not see them. And just where the upper wings are inserted, are a couple of scales, covered with tufts of hair, so that they hook like epaulets, and are called tippets.

The corslet,* or breast of the butterfly, is very strong, because the upper wings and the legs are fixed in it; and it contains the muscles by which they are moved. The true legs of the caterpillar, as I told you before, inclosed those of the butterfly. They are six in number, but four only are made use of; the two fore-legs are so short, they do not touch the ground, and are almost hidden by the long hairs that clothe the body.

The antennæ of the butterfly are hollow, and have a great many joints. There are two of these antennæ; and they get thicker towards the tip, and end in a little knob or club, which is of a different shape in different species.

It would be impossible to describe the endless variety of butterflies that flit about us in the summer. Our gardens, meadows, woods, and lanes, are gay with them, and we hardly know which most to admire.

* Thorax is the scientific term.

There is the yellow butterfly,* that comes before the winter is over. Very often she has lived through it, in some sheltered nook, and the first sunny day in March, or even earlier, you may see her fluttering her wings, that are as delicate as the petals of the early primrose.

Then there are the white butterflies,† that are more numerous than any. Even in the coldest and most cheerless summer, they will flutter about in every transient gleam of sunshine. In the caterpillar state, they have been destructive enough, but now their voracious habits are ended, and they come out, decked in snowy plumes, to enjoy life after a different fashion.

There is the peacock butterfly,‡ with many-coloured spots, like eyes upon her wings, and myriads of a smaller kind, with bright blue wings,§ and wings of a violet hue, that dance about in the hay-fields, and then disappear until the corn is ripe; and brilliant little copper-colored butterflies‖ that live amongst the reeds, and shine in the sun as if their wings were made of metal.

In the tropics, where everything grows to a much larger size than it ever does here, the butterflies are very splendid indeed.

* Papilio rhamni, &c. † Pontia charidea, and others.
‡ Vanessa io. § Polyommatus. ‖ Lycæna.

Fancy a magnificent butterfly,* as large as a bird; with wings of a deep velvetty black, with broad stripes of green, that shine like silk, and spots of black and orange, that sparkle like gold. Or another, a long-tailed butterfly,† of a dark brown colour, with patches of the most brilliant blue, and sprinkled all over with points of green, that make the wings look as if they were powdered with gold dust. Or a third, with one pair of wings of a golden green, and the other pair of a bright flame colour, that changes to purple, or flashes into red, while you are looking at it.

Another is called Urania, and as Urania means heavenly, it is a very suitable name. This butterfly‡ is found only in the West Indian Islands, and is never seen in the heat of the day, but reposes on the under-side of leaves, and so protects herself from the fierce rays of the sun.

A traveller in Jamaica was very anxious to see her, and watched for her coming every day. But it was not until the spring, when the blossoms of the pear-trees were all bursting forth, that she made her appearance. At first, only one or two arrived, and they came before it was light in the morning. But by and bye, numbers of them began to flutter about the blossoms, and

* Ornithoptera priamus. † Papilio Paris. ‡ U. Sloanus.

to suck their juices. They chased each other about, their wings glistening in the sun like the

Urania.

plumage of the humming-bird; then they dashed headlong over the loftiest trees, and soared so high, they were only just visible as tiny specks, moving against the bright blue sky. Before the sun grew hot, they had all retired, and by mid-day not one was to be seen.

The Urania has wings of a velvet black, striped with emerald green, notched round the edge with a band of ruddy gold, and projecting into a long and slender tail. She seems to belong to an intermediate species, for her antennæ have not the little clubs or knobs at the end, like the rest of the butterflies, but taper off to a point like those of a moth.

A traveller in India tells us that he was very much delighted with the amazing number of splendid butterflies of the swallow-tail species. They were to be seen everywhere, sailing majestically through the still hot air, or fluttering from one scorching rock to another. But they seemed to like best of all the damp warm sand by the side of a stream. There they would settle and sit by thousands, with erect wings, and balancing themselves with a rocking motion, as their heavy sails inclined them to one side or the other. Altogether, they looked like a fleet of yachts at anchor, in a calm.

Perhaps you do not know that there are some people in the world who eat butterflies!

Do you remember my telling you that in New South Wales, the natives took a great deal of trouble, and even climbed the trees to find caterpillars, and then cooked and ate them? It is in the same country that they use a little

butterfly as an article of food. They call her "the Bugong," and at a certain season of the year, immense flights of these butterflies are to be seen upon a mountain that is named, on this account, the Bugong mountain.

The butterflies rise from the lowland in such incredible numbers that the air is filled with them. They settle on the masses of granite that form the different peaks of the mountain, and completely cover them, and fill up every hollow.

The natives come from far and near to make a harvest of them; and while the season lasts, nothing is thought of but feasting on the Bugong. They light fires in the hollows of the rocks, and the butterflies are suffocated with the smoke. They are swept up by bushels, and then the natives set to work to prepare them for food.

A space is cleared, large enough for the purpose, and a fire kept burning on it, until the earth is quite hot. After the fire is removed, they heap the butterflies upon the heated place to bake, and stir them about until the wings and down fall off; for the body is the only part used as food. Sometimes the bodies are eaten without any further preparation, but more frequently they are put into a wooden bowl, and pounded into cakes, about the color and consistence of dough, and that look like lumps of fat. The

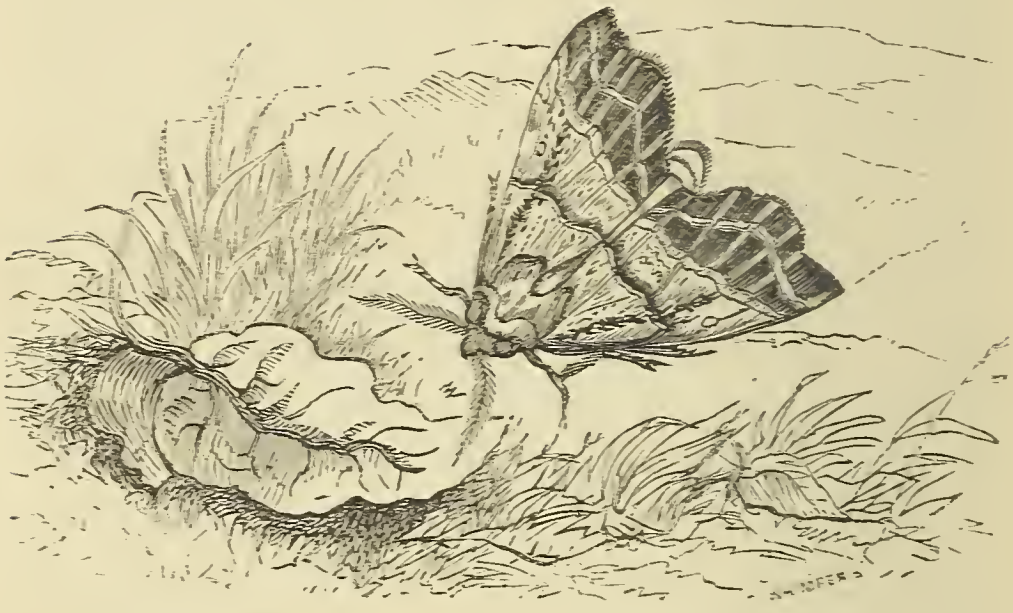
natives eat as many of these cakes as they can; and what are left over are hung up in the smoke to dry, and are thus preserved for some time longer.

A traveller once went up the Bugong to see the gathering in of the butterfly harvest. He was just too late, for the natives had cleared them all off, and he found only the deserted huts, and the remains of the fires that had been kindled. He contrived, however, to pick up a few straggling butterflies that were left behind, and carried them away with him. When he got back to his quarters, the natives, who had heard of his exploit, came crowding round him, expecting to be feasted with cakes. They were not a little disappointed, when he showed them his butterflies, and told them they were not to be eaten, but preserved as specimens. This did not satisfy them at all, and they went away, expressing both surprise, and contempt, at the traveller's want of taste.

Speaking of the flights of the Bugong, reminds me that it is no uncommon thing for butterflies to migrate, in countless numbers, from one place to another.

A traveller in Ceylon saw several of these flights, and they generally happened in April or May. The butterflies passed over in an immense

cloud, that looked as if it were miles in breadth; and so long, that it was some days before it came to an end. The butterflies took a north-easterly direction; but where they came from, or where they were going, no one could tell.



A moth at rest.

CHAPTER THE THIRTEENTH.

THE MOTH.

The butterfly is a creature of light and sunshine; and is called a day-flyer, because, as soon as the sun sets, and the flowers fold up their petals, she retires, and is no longer seen upon the wing. But when the butterfly is gone, then out comes the moth. She is called the night-flyer; for she loves the misty twilight, or the sombre hours of night.

Her appearance is in unison with her habits. The color of her wings is subdued and grave, and well adapted to the sort of life she has to lead. All day she lies hidden in the cleft of a tree, or in some shady corner, where her sober drapery prevents her being noticed; but when the sun is down, she issues forth, and often continues her flight until the dawn of morning. Her great enemies are the owl and the bat, who are wheeling about in the darkness, and depend very much on the night-flying insects for food.

The moth differs from the butterfly in the structure of her antennæ, and in the way she has of holding her wings when at rest.

Her antennæ, instead of getting thicker and thicker towards the tip as the butterfly's do, grow more and more slender, and taper off to a point. Sometimes they look like two feathers, for they are fringed on either side, with minute branchlets, that are finely cut, and covered with scales or plumes, like those upon the wing.

In some cases, the antennæ are very long and delicate. One little moth is called "long horn," because her antennæ are five times as long as she is herself. They are as slender as the finest threads of gossamer, and you would hardly see them, but for the sunlight glancing, every now and then, upon them. She flies amongst the thickest foliage of the trees, and you wonder how she can carry her horns unhurt. But she seems to have no difficulty

Feathered antennæ.

about it; and long as they are, they never get injured.

The butterfly, as you know, holds her wings erect when she settles on a flower, but the moth never does. Even when at rest, they are held in a horizontal manner, and very often, just in the same position as when the insect is flying. They are furnished with a curious apparatus, that keeps them steady, and will not allow them to stand upright. Beneath the upper wings, and attached to them, there is a hook; and to the base of the other pair of wings, there grows a bristle, which goes into it. When the moth opens or shuts her wings, the bristle does not come out of the hook, but moves backwards and forwards, and keeps them always inclined. The female moth flies about very little, and though she often has the bristle, she never has the hook.

The wings of moths grow in a great many different ways, and the difference serves to divide them into groups.

Many of the smaller moths have their wings rolled round and round, and sometimes the wings completely embrace the body.

One species is called "notch wings," because the moths have notches on the edges of the wings, as if a round piece had been cut out. Some of these moths look very much like

withered leaves, gnawed round the edge by insects. If they are disturbed, they do not fly, but choose a more cunning way of escape. They drop to the ground, and lie there quite still, so that they are lost to sight, amongst the grass and leaves.

The lappet-moth is not uncommon; but if you saw her reposing, you would take her for a bundle of withered leaves. One pair of her wings projects very much beyond the other, and both are notched round, like the edges of a leaf. She is called "lappet," because when she was a caterpillar, she had fleshy protuberances or "lappets" along her sides.

Clear-wings.

There are no butterflies or moths to be found without the scales or plumes, that I described to you, upon their wings. But there is a family of moths that have them only fringing the edges, or covering the nervures, and they are called "clear-wings," because the rest of the wing is quite transparent. They are so much like flies and wasps, that you would not think they were moths at all; and on this account, they are named "bee-clear-wing," "hornet-clear-wing," "gnat-clear-wing," "fly-clear-wing."

Another group of moths is called "plumed moths," because the wings are cut up into very narrow strips, like feathers.

The white-plumed moth is constantly to be seen in hedges and lanes; and her wings are

Many-plumed moth.

of a snowy-white, with a silky gloss upon them. But the many-plumed moth, that comes creeping on the inside of the window pane, towards the end of autumn, is more beautiful still. Her wings are divided into as many as a dozen of these feathery strips, and are of a silver-grey, with a black spot upon each tip.

You have heard of the butterfly, whose wings seem to change color while you are looking at them; and some moths have the same peculiarity.

There is one foreign moth* that has patches of green upon the wings, but when you look at them in a different light, they appear to be blue; and so are like the chameleon, about which the countryman quarrelled. A naturalist once employed some persons to make drawings of this insect. One painted the wings green, and the other painted them blue, and each obstinately maintained he was right. And so he was, for they had looked green to him, and blue to his neighbour; and in fact, both were right, and both were wrong.

Each species of moth has its own particular mode of flying; and this, no doubt, depends upon the size and structure of the wings.

* Erasmia pulchella.

One group of moths is called skippers,* because their flight consists of a succession of jerks or skips.

The skippers may be considered as a connecting link between the butterflies and the moths. In some respects they resemble the butterfly, for their antennæ get thicker towards the tip, and end in a club; and they hold the upper pair of wings erect, as the butterfly does when she is resting, but the under pair of wings are kept in a horizontal position, like those of a moth.

Moths are attracted by a light; and as they always fly towards it, they may be caught by opening a window, and letting a lamp be seen. They come out in succession, at different hours of the night. As for instance, one species will be abroad from seven till ten, and then another will appear, and fly till one or two in the morning; and so on, until the dawn of day.

And they have their own peculiar ways of coming into the room, so that a naturalist can tell which species a moth belongs to, before he sees her. One will fly downwards, and announce herself by a knock upon the floor; another will mount up to the ceiling, and beat against it with her wings. A third will enter very gently, and fall upon the table like a flake of snow; while

* Hesperidæ.

many others bluster about in a very amusing and obstreporous manner.

The trunk of the moth is much more simple than that of the butterfly, and consists but of one tube.

But what is very singular, some moths have neither mouth nor trunk of any kind, and can never take any food.

The ghost-moth* is one of these. You will wonder how any moth came to have such an uncomfortable name. One reason is, that the wings are of a satiny-white, and their edges are tipped with yellow. The female moth very seldom flies, and when her partner has discovered her retreat, he keeps hovering over it, moving up and down, and from side to side, but never quitting the spot. From his being so constantly in one place, he is said to haunt it; and this, joined to the phantom-like appearance of his snowy wings, has given him the name of "ghost-moth."

You remember how careful the moths were of their eggs, and how they fastened them with gum to the branches, and even covered them over with down. But the female of the ghost-moth, takes no care of her eggs at all, and throws them to a distance, without either gum or covering. At first, they are white, but they

* Hypialus humuli.

soon become black, and look just like grains of gunpowder.

Speaking of eggs, reminds me of another anecdote, I might have told you before, with regard to the instinct of moths for their eggs. It is about the little moth, that comes out of the grain of wheat, in the farmer's granary. There are two generations of these moths in the course of the year; and the first make their appearance in May or June. But they do not stay in the granary, though they have lived there all their lives: they fly off to the corn-fields, and lay their eggs upon the growing wheat; as if they knew that the ears would soon be ripe, and yield an abundant supply of food for the young caterpillars. Late in the autumn, when the corn has been gathered in, and stored in the granary, the second generation of moths come out. But they never attempt to fly away to the fields, as the others did; for they seem to know that the harvest is over, and the corn-fields all reaped and bare. So they lay their eggs in the granary, on the store of wheat that is close at hand, and that will furnish their infant progeny with food.

The foreign moths, as well as the butterflies, are very much larger, and more splendid than any we have in England.

The caterpillar, called the hickory-horned devil, and that frightens people by setting up its crest of spines, comes into a very magnificent moth indeed. It has been named regalis, or kingly, on account of its royal appearance, and is as gaily painted as a butterfly. The wings are of a dark brown color, with bright red veins; and have bands and patches upon them, of the most brilliant yellow.

Another moth is called the imperialis, because of its emperor-like costume. The wings are bright yellow, spotted all over with red, and have a purple gloss upon them, as if they had been

sprinkled with purple dust. And a third is called rosalia, because the wings are of a deep rose-red. They are fringed and streaked with yellow, and change their hue according to the light you see them in.

And there is an elegant moth, with a very small body, that seems almost lost between its large cream-coloured wings, which end in a tail, a little like the swallow-tail butterfly.

And there are the leopard and ermine moths, with white wings spotted with blue and black, that give them a very dazzling appearance.

The female moths are not so gaily colored as their partners. And it is very curious, that their partners have sometimes odd wings; one being gay with clouds and spots, and the other quite plain, and having no color at all, like that of the female. At first sight, you might think some one had been playing a prank, and giving to the moth a wing that did not belong to him. But such is not the case, and Nature alone is answerable for this phenomenon.

The largest moth of all, is called the owl moth,* and is quite a giant, compared to any we see in England. All day, he lies motionless on the forked branch, or cleft of a tree; and is so much

* Erebus.

the color of the bark, that he can hardly be distinguished from it. But if disturbed, out he darts, looking like a great bat; for he is quite as large, and dances about up and down, and from side to side, with such rapidity, that you can scarcely see where he is. And then, he suddenly disappears, either alighting on the very spot from which he arose, or becoming lost to sight amongst the maze of stems.

One family of moths do not fly at night, but come out in the dusk of morning or evening; and a few of them are to be seen sporting about with the butterflies at noon-day. They are, in fact, the twilight-flyers; and the name of sphinx has been given to them, because, in their caterpillar-state, they hold their heads erect, and sit in an attitude, a little like that of the ancient sphinx. They are likewise called hawk-moths, because they poise themselves in the air as hawks do hovering over the flower, as the bird does over his prey. Their wings are long and narrow, and they have a more bird-like way of flying, than the other moths. They fly in a direct line, and very swiftly, instead of merely fluttering about; and this superior power is owing to the strong muscles, contained in their thick and massive bodies.

The antennæ of the sphinxes are the thickest in the middle, and taper off to a point at each end; but they hold their wings inclined, like the rest of the moths; and have the hook and bristle to keep them steady.

They make a humming noise as they hover over a flower; and their habit of feeding on the wing, and their rapid manner of darting about, makes them so much like humming-birds, that some of them are called humming-bird hawk-moths.

One of these humming-bird moths, is not uncommon in England, and flies morning and evening, hiding itself in the noon-time, amongst the foliage. It frisks about all the summer, darting from flower to flower, or poising itself over them, while it sucks up their juices with its long spiral trunk. The jessamine and carnation are its favorite flowers, and as it hovers over them, with quivering wings, its large and hawk-like eyes survey everything around it. At the least movement, it is alarmed, and darts away with the speed of an arrow.

This keen sight and rapid movement, are its greatest safeguards. It is scarcely possible to catch it; and when at rest, it takes care to settle on some dusky body, so nearly its own

color, that it cannot be detected. Sometimes it will fly into a room, attracted by the sweet scent of flowers; but in a moment, as if aware of the risk it is running, out it darts, and is gone almost before you can see it. And even when it has been caught, and put in a box, it pretends to be dead, and falls upon its back. But no sooner does a fitting opportunity come, than up it springs, and is out of sight in an instant.

Humming-bird hawk-moth.

And now it is time for me to take leave of my little readers; and in doing so, I sincerely hope they have read the foregoing pages with interest, and gleaned from them a few facts they did not know before.

There is indeed, no end to the wonders of Nature, which science alone can enable us to trace out, and teach us to observe. But, however much science may teach us, she would be unworthy of her name, if she failed to discover the mighty hand of the Creator; and to bow in humble adoration before the power and wisdom, the harmony and beauty, which pervade the works of Him who is Eternal.

And there is a pleasant reflection that must suggest itself to everybody, while studying the wonderful works of God.

"When we see such paternal care manifested for the welfare of beings so frail, that a mere touch would dissipate them, we cannot but assent to the observation of the Psalmist, that 'His tender mercies are over all His works;' the least and most insignificant, as well as the largest and most elevated, in the animal kingdom. And we may feel a comfortable assurance, that the eye which regards even these seemingly insignificant creatures, will, if we cast not off

our confidence, never overlook *us*, or be indifferent to *our* welfare."

A moth with odd wings.

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